MESTI DIMILIKI

SASBADI

KERTAS MODEL SPM

Sijil Pelajaran Malaysia

6

FORMAT MULAI 2021

Additional Mathematics
Matematik Tambahan

BILINGUAL DWIBAHASA

(3472/1, 3472/2)

SHAHMI BELLINGHAM G2

FORMAT INSTRUMEN SPM MATEMATIK TAMBAHAN MULAI TAHUN 2021

BIL.	PERKARA	KERTAS 1 (3472/1)	KERTAS 2 (3472/2)
1	Jenis Instrumen	Ujian Bertulis	Ujian Bertulis
2	Jenis Item	• Subjektif Respons Terhad • Subjektif Berstruktur	• Subjektif Respons Terhad • Subjektif Berstruktur
3	Bilangan Soalan	**Bahagian A** 12 soalan (64 markah) (Jawab **semua** soalan) **Bahagian B** 3 soalan (16 markah) (Jawab **2** soalan)	**Bahagian A** 7 soalan (50 markah) (Jawab **semua** soalan) **Bahagian B** 4 soalan (30 markah) (Jawab **3** soalan) **Bahagian C** 4 soalan (20 markah) (Jawab **2** soalan)
	Jumlah Markah	80 markah	100 markah

EKSKLUSIF
Jawapan Lengkap Berserta Langkah Penyelesaian

Nur Hazirah Baharin
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NO. KAD PENGENALAN | | | | | | | - | | - | | | | |

ANGKA GILIRAN | | | | | | | | |

KERTAS MODEL 1

MODEL SIJIL PELAJARAN MALAYSIA

ADDITIONAL MATHEMATICS — 3472/1

Kertas 1

2 jam — **Dua jam**

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1. Kertas peperiksaan ini adalah dalam dwibahasa.
2. Soalan dalam bahasa Inggeris mendahului soalan yang sepadan dalam bahasa Melayu.

INFORMATION FOR CANDIDATES
MAKLUMAT UNTUK CALON

1. This question paper consists of **15** questions.
   Kertas peperiksaan ini mengandungi ***15*** *soalan.*
2. Answer **all** the questions in **Section A** and any **two** questions from **Section B**.
   Jawab ***semua*** *soalan dalam* ***Bahagian A*** *dan mana-mana* ***dua*** *soalan daripada* ***Bahagian B****.*
3. Write your answers in the spaces provided in the question paper.
   Tulis jawapan anda dalam ruang yang disediakan dalam kertas peperiksaan.
4. Show your working. It may help you to get marks.
   Tunjukkan langkah-langkah penting dalam kerja mengira anda. Ini boleh membantu anda mendapatkan markah.
5. The diagrams provided in the questions are not drawn to scale unless stated.
   Rajah yang mengiringi soalan tidak dilukis mengikut skala kecuali dinyatakan.
6. You may use a scientific calculator.
   Anda dibenarkan menggunakan kalkulator saintifik.

Untuk Kegunaan Pemeriksa			
Kod Pemeriksa:			
Bahagian	**Soalan**	**Markah Penuh**	**Markah Diperoleh**
A	**1**	**5**	
	2	**5**	
	3	**6**	
	4	**4**	
	5	**5**	
	6	**6**	
	7	**5**	
	8	**6**	
	9	**5**	
	10	**6**	
	11	**5**	
	12	**6**	
B	**13**	**8**	
	14	**8**	
	15	**8**	
Jumlah		**80**	

Section A
Bahagian A

[64 *marks*/64 *markah*]

Answer **all** the questions.
Jawab **semua** *soalan.*

1 Diagram 1 shows the graph of a quadratic function $f(x)$ with a minimum point (2, 5) and the y-intercept is 10.
Rajah 1 *menunjukkan graf bagi fungsi kuadratik* $f(x)$ *dengan titik minimum* (2, 5) *dan pintasan-y ialah* 10.

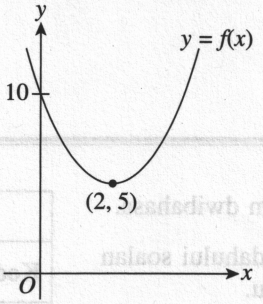

Diagram 1/*Rajah* 1

(a) Find the quadratic function in the form $f(x) = a(x - b)^2 + c$.
Cari fungsi kuadratik itu dalam bentuk $f(x) = a(x - b)^2 + c$.

[3 *marks*/3 *markah*]

(b) Find the quadratic function $g(x)$ of a curve obtained when the curve of function $f(x)$ is reflected in the y-axis.
Cari fungsi kuadratik $g(x)$ *bagi lengkung yang diperoleh apabila lengkung fungsi* $f(x)$ *dipantulkan pada paksi-y.*

[2 *marks*/2 *markah*]

Answer/*Jawapan*:

(a)

(b)

2 (a) Given a function $f : x \rightarrow |\, 7 - 4x \,|$, find the objects with an image of 11.
Diberi fungsi $f : x \rightarrow |\, 7 - 4x \,|$, *cari objek-objek dengan imej* 11.

[3 *marks*/3 *markah*]

(b) Given the functions $g : x \rightarrow 4x + 3$ and $g^{-1}(15) = k$. Find the value of k.
Diberi bahawa fungsi $g : x \rightarrow 4x + 3$ *dan* $g^{-1}(15) = k$. *Cari nilai k.*

[2 *marks*/2 *markah*]

Answer/*Jawapan*:

(a)

(b)

---

3 It is given that $2^y = p$ and $3^y = q$. Express each of the following in terms of p and q.
Diberi bahawa $2^y = p$ *dan* $3^y = q$. *Ungkapkan setiap yang berikut dalam sebutan p dan q.*

(a) $81^{2y} - 6^{2y}$

[3 *marks*/3 *markah*]

(b) $12^y \times 16^{y+1}$

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

4 Given that $\log_2 (m + 5) = 3(\log_2 n + 2)$, express m in terms of n.
Diberi $\log_2 (m + 5) = 3(\log_2 n + 2)$, *ungkapkan m dalam sebutan n.*

[4 *marks*/4 *markah*]

Answer/*Jawapan*:

---

5 The sum of the first 14 terms of an arithmetic progression is 175. If the first term is –20,
Hasil tambah 14 *sebutan pertama suatu janjang aritmetik ialah* 175. *Jika sebutan pertamanya ialah* –20,

(a) find the common difference of the progression.
cari beza sepunya bagi janjang itu.

[3 *marks*/3 *markah*]

(b) find the 14th term of the progression.
*cari sebutan ke-*14 *bagi janjang itu.*

[2 *marks*/2 *markah*]

Answer/*Jawapan*:

(a)

(b)

6 Diagram 6 shows a straight line graph obtained by plotting $\log_2 y$ against $\log_2 x$. The variables x and y are related by the equation $y = px^{3q}$, where p and q are constants.
Rajah 6 menunjukkan satu graf garis lurus yang diperoleh dengan memplot $\log_2 y$ *melawan* $\log_2 x$. *Pemboleh ubah x dan y dihubungkan oleh persamaan* $y = px^{3q}$, *dengan keadaan p dan q ialah pemalar.*

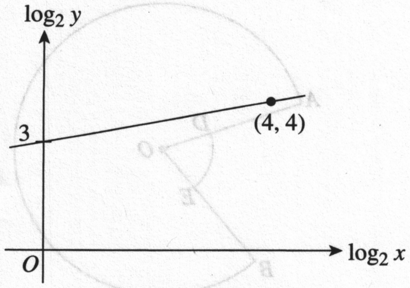

Diagram 6/*Rajah* 6

Find
Cari

(a) the values of p and q.
nilai p dan nilai q.

[3 *marks*/3 *markah*]

(b) the value of x when $y = 6$.
nilai x apabila $y = 6$.

[3 *marks*/3 *markah*]

Answer/*Jawapan*:
(a)

(b)

7 Diagram 7 shows two sectors, *AOB* and *DOE*, of two circles with common centre *O*. The angle subtended at the centre *O* by the major arc *AB* is $10a$ rad and the perimeter of the whole diagram is $(12r + 70)$ cm.
Rajah 7 menunjukkan dua sektor bulatan, AOB dan DOE, dengan pusat sepunya O. Sudut yang dicangkum pada pusat O oleh lengkok major AB ialah $10a$ rad *dan perimeter seluruh rajah itu ialah* $(12r + 70)$ cm.

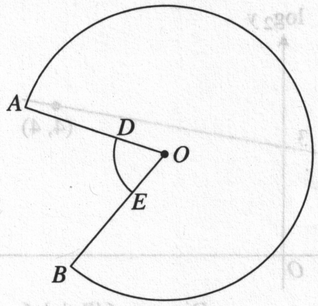

Diagram 7/*Rajah 7*

It is given that $OD = 2r$ cm, $OB = 4OE$ and $\angle DOE = 2b$ rad. Express
Diberi bahawa $OD = 2r$ cm, $OB = 4OE$ *dan* $\angle DOE = 2b$ rad. *Ungkapkan*

(a) b in terms of a.
b dalam sebutan a.

[2 *marks*/2 *markah*]

(b) r in terms of a.
r dalam sebutan a.

[3 *marks*/3 *markah*]

Answer/*Jawapan*:
(a)

(b)

8 (a) Given that $h(x) = (1 - 2x)^3$, evaluate $h'(1)$.
Diberi $h(x) = (1 - 2x)^3$, *nilaikan* $h'(1)$.

[2 marks/2 *markah*]

(b) Given a straight line $2x + 3py = 15$ is perpendicular to the tangent of a curve $y = \dfrac{x}{2x - 1}$ at point (2, 3). Find the value of p.

Diberi garis lurus $2x + 3py = 15$ *adalah berserenjang dengan tangen kepada lengkung* $y = \dfrac{x}{2x - 1}$ *pada titik* (2, 3). *Cari nilai p.*

[4 marks/4 *markah*]

Answer/*Jawapan*

(a)

(b)

---

9 Given that $\int_3^6 g(x)\, dx = \frac{7}{2}$, find

Diberi $\int_3^6 g(x)\, dx = \frac{7}{2}$, *cari*

(a) $\int_6^3 \frac{1}{2} g(x)\, dx$.

[2 marks/2 *markah*]

(b) the value of q such that $\int_3^6 [g(x) - 2q]\, dx = 16$.
nilai q dengan keadaan $\int_3^6 [g(x) - 2q]\, dx = 16$.

[3 marks/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

10 (a) There are 4 girls and 3 boys to be arranged in a row for a photograph session. Find the number of ways to arrange them if the 3 boys want to sit side by side.
Terdapat 4 *orang murid perempuan dan* 3 *orang murid lelaki hendak disusun dalam sebaris untuk satu sesi fotografi. Cari bilangan cara untuk menyusun mereka jika* 3 *orang murid lelaki itu mahu duduk bersebelahan.*

[3 *marks*/3 *markah*]

(b) A teacher committee that consists of 5 teachers is to be chosen from 4 male teachers and 4 female teachers. Find the number of different ways the committee can be formed if at least one male teacher must be selected.
Suatu jawatankuasa guru yang terdiri daripada 5 *orang guru akan dipilih daripada* 4 *orang guru lelaki dan* 4 *orang guru perempuan. Cari bilangan cara berlainan jawatankuasa itu boleh dibentuk jika sekurang-kurangnya seorang guru lelaki mesti dipilih.*

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a) (b)

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11 Given cos $\theta = m$, where $180° \leqslant \theta \leqslant 360°$. Find each of the following in terms of m.
Diberi kos $\theta = m$, *dengan keadaan* $180° \leqslant \theta \leqslant 360°$. *Cari setiap yang berikut dalam sebutan m.*

(a) tan θ

[2 *marks*/2 *markah*]

(b) cosec 2θ
kosek 2θ

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a) (b)

12 (a) In a basket that consists of red and green apples, it is found that 30% of the apples are green apples. If 5 apples are chosen at random, find the probability that at least 3 red apples are chosen.
Di dalam sebuah bakul yang mempunyai epal merah dan epal hijau, didapati bahawa 30% *daripada epal itu ialah epal hijau. Jika* 5 *biji epal dipilih secara rawak, cari kebarangkalian bahawa sekurang-kurangnya* 3 *biji epal merah dipilih.*

[3 *marks*/3 *markah*]

(b) The masses of the students in a secondary school are normally distributed with a mean of x kg and a standard deviation of 5 kg. If 2.28% of the students have masses more than 50 kg, find the value of x.
Jisim murid-murid di sebuah sekolah menengah bertaburan secara normal dengan min x kg *dan sisihan piawai* 5 kg. *Jika* 2.28% *daripada murid-murid itu mempunyai jisim melebihi* 50 kg, *cari nilai* x.

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

Section B
Bahagian B

[16 *marks*/16 *markah*]

Answer any **two** questions from this section.
Jawab mana-mana **dua** *soalan daripada bahagian ini.*

13 A piece of wire with a length of 352 cm is cut and bent to form 8 squares.
Seutas dawai yang panjangnya 352 cm *dipotong dan dibengkokkan untuk membentuk* 8 *segi empat sama.*

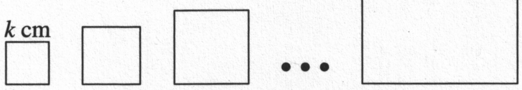

Diagram 13/*Rajah* 13

The length of sides of each square is 2 cm more than the length of sides of the previous square. Given the length of sides of the smallest square is k cm.
Panjang sisi setiap segi empat sama adalah 2 cm *lebih daripada panjang sisi segi empat sama sebelumnya. Diberi panjang sisi segi empat sama yang paling kecil ialah k* cm.

(a) Find the value of k.
Cari nilai k.

[4 *marks*/4 *markah*]

(b) Which square has a perimeter of 56 cm?
Segi empat sama yang manakah mempunyai perimeter 56 cm?

[4 *marks*/4 *markah*]

Answer/*Jawapan*:

(a)

(b)

14 Diagram 14 shows a triangle *LMN*. *Q* is the midpoint of *LM* and the straight line *QN* intersects the straight line *MR* at point *P*. It is given that $4NR = NL$, $\overrightarrow{NR} = 3\underset{\sim}{x}$ and $\overrightarrow{NM} = 8\underset{\sim}{y}$.
Rajah 14 menunjukkan segi tiga LMN. Q ialah titik tengah LM dan garis lurus QN bersilang dengan garis lurus MR pada titik P. Diberi bahawa $4NR = NL$, $\overrightarrow{NR} = 3\underset{\sim}{x}$ *dan* $\overrightarrow{NM} = 8\underset{\sim}{y}$.

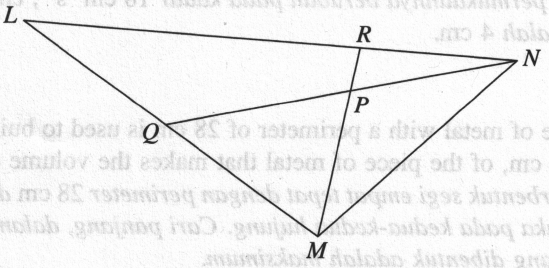

Diagram 14/*Rajah* 14

(a) Express each of the following in term of $\underset{\sim}{x}$ and $\underset{\sim}{y}$.
Ungkapkan setiap yang berikut dalam sebutan $\underset{\sim}{x}$ *dan* $\underset{\sim}{y}$.

(i) $\overrightarrow{RM}$ (ii) $\overrightarrow{NQ}$

[3 *marks*/3 *markah*]

(b) (i) Given $\overrightarrow{PM} = k\overrightarrow{RM}$, express $\overrightarrow{PM}$ in terms of k, $\underset{\sim}{x}$ and $\underset{\sim}{y}$.
Diberi $\overrightarrow{PM} = k\overrightarrow{RM}$, *ungkapkan* $\overrightarrow{PM}$ *dalam sebutan* k, $\underset{\sim}{x}$ *dan* $\underset{\sim}{y}$.

(ii) Given $\overrightarrow{PQ} = h\overrightarrow{NQ}$, express $\overrightarrow{PQ}$ in terms of h, $\underset{\sim}{x}$ and $\underset{\sim}{y}$.
Diberi $\overrightarrow{PQ} = h\overrightarrow{NQ}$, *ungkapkan* $\overrightarrow{PQ}$ *dalam sebutan* h, $\underset{\sim}{x}$ *dan* $\underset{\sim}{y}$.

(iii) Hence, find the values of k and h.
Seterusnya, cari nilai k dan nilai h.

[5 *marks*/5 *markah*]

Answer/*Jawapan*:
(a)

(b)

15 (a) The surface area of a sphere is given by the equation $A = 3\pi x^2 + \frac{48\pi}{x}$, where x is the radius of the sphere. If the surface area changes at a rate of 18π cm^2 s^{-1}, find the rate of change in the radius when its radius is 4 cm.
Luas permukaan sebuah sfera diberi oleh persamaan $A = 3\pi x^2 + \frac{48\pi}{x}$, *dengan keadaan x ialah jejari sfera itu. Jika luas permukaannya berubah pada kadar* 18 cm^2 s^{-1}, *cari kadar perubahan dalam jejari apabila jejarinya ialah* 4 cm.

[4 *marks*/4 *markah*]

(b) A rectangular piece of metal with a perimeter of 28 cm is used to build an open cylinder at both ends. Find the length, in cm, of the piece of metal that makes the volume of the cylinder a maximum.
Sekeping logam berbentuk segi empat tepat dengan perimeter 28 cm *digunakan untuk membina sebuah silinder yang terbuka pada kedua-kedua hujung. Cari panjang, dalam* cm, *kepingan logam itu supaya isi padu silinder yang dibentuk adalah maksimum.*

[4 *marks*/4 *markah*]

Answer/*Jawapan*:

(a)

(b)

END OF QUESTION PAPER

KERTAS PEPERIKSAAN TAMAT

KERTAS MODEL 1

MODEL SIJIL PELAJARAN MALAYSIA

ADDITIONAL MATHEMATICS 3472/2

Kertas 2

2 jam 30 minit **Dua jam tiga puluh minit**

1. Kertas peperiksaan ini adalah dalam dwibahasa.
2. Soalan dalam bahasa Inggeris mendahului soalan yang sepadan dalam bahasa Melayu.

INFORMATION FOR CANDIDATES
MAKLUMAT UNTUK CALON

1. This question paper consists of three sections: **Section A**, **Section B** and **Section C**.
   Kertas peperiksaan ini mengandungi tiga bahagian: ***Bahagian* A**, ***Bahagian* B** *dan* ***Bahagian* C**.
2. Answer **all** the questions in **Section A**, any **three** questions from **Section B** and any **two** questions from **Section C**.
   Jawab **semua** *soalan dalam* ***Bahagian* A**, *mana-mana* **tiga** *soalan daripada* ***Bahagian* B** *dan mana-mana* **dua** *soalan daripada* ***Bahagian* C**.
3. Show your working. It may help you to get marks.
   Tunjukkan langkah-langkah penting dalam kerja mengira anda. Ini boleh membantu anda mendapatkan markah.
4. The diagrams provided in the questions are not drawn to scale unless stated.
   Rajah yang mengiringi soalan tidak dilukis mengikut skala kecuali dinyatakan.
5. You may use a scientific calculator.
   Anda dibenarkan menggunakan kalkulator saintifik.

Section A
Bahagian A

[50 *marks*/50 *markah*]

Answer **all** the questions in this section.
Jawab **semua** *soalan dalam bahagian ini.*

1 In a certain week, a furniture shop sold a total of 28 units of tables, chairs and racks. The number of racks sold was more than the number of chairs sold. The difference between the number of racks and chairs sold is 2 units more than the number of tables sold. The total income in that week was RM33 300. The prices of each table, chair and rack are RM1 550, RM750 and RM1 250 respectively.
Dalam suatu minggu tertentu, sebuah kedai perabot menjual sebanyak 28 unit meja, kerusi dan rak. Bilangan rak yang dijual adalah lebih daripada bilangan kerusi yang dijual. Beza antara bilangan rak dan kerusi yang dijual adalah 2 unit lebih daripada bilangan meja yang dijual. Jumlah hasil jualan dalam minggu itu ialah RM33 300. *Harga setiap meja, kerusi dan rak masing-masing ialah* RM1 550, RM750 *dan* RM1 250.

(a) Construct a system of linear equations based on the above conditions.
Bina satu sistem persamaan linear berdasarkan syarat di atas.

[3 *marks*/3 *markah*]

(b) Find the number of units for each item sold in that week.
Cari bilangan unit setiap jenis barangan yang dijual dalam minggu itu.

[4 *marks*/4 *markah*]

2 Diagram 2 shows a right conical container with a height of 10 cm. Water is poured into the container such that the height, x cm, of the water level is increasing at a constant rate of 0.5 cm s^{-1}.
Rajah 2 *menunjukkan sebuah bekas berbentuk kon tegak dengan tingginya* 10 cm. *Air dituangkan ke dalam bekas itu dengan keadaan tinggi, x* cm, *paras air bertambah pada kadar tetap* 0.5 cm s^{-1}.

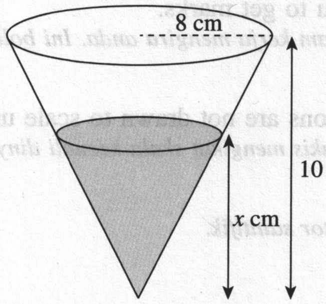

Diagram 2/*Rajah* 2

(a) Show that the volume, V cm^3, of the space that is not filled with water is given by:
Tunjukkan bahawa isi padu, V cm^3, *ruang yang tidak berisi air diberi oleh:*

$$V = \frac{16}{3}\pi\left(40 - \frac{x^3}{25}\right)$$

[3 *marks*/3 *markah*]

(b) Calculate the rate of change in the volume of the space that is not filled with water when $x = 5$.
Hitung kadar perubahan dalam isi padu ruang yang tidak berisi air apabila $x = 5$.

[4 *marks*/4 *markah*]

3 (a) A function k is given as $k : x \rightarrow 2x - 6$. Find
Suatu fungsi k diberi sebagai $k : x \rightarrow 2x - 6$. *Cari*

(i) $k^{-1}(x)$.

(ii) the value of m such that $k^2\left(\frac{2}{3m}\right) = 4$.

nilai m dengan keadaan $k^2\left(\frac{2}{3m}\right) = 4$.

[3 *marks*/3 *markah*]

(b) Sketch the graph of $g(x) = |\, 2x + 1 \,|$ for $-3 \leqslant x \leqslant 4$. Hence, state the range of $g(x)$.
Lakarkan graf bagi $g(x) = |\, 2x + 1 \,|$ *untuk* $-3 \leqslant x \leqslant 4$. *Seterusnya, nyatakan julat bagi* $g(x)$.

[4 *marks*/4 *markah*]

4 Diagram 4 shows a semicircle *OPQR* with centre *O* and a radius of 10 cm. *PST* is a sector of a circle with centre *S* and a radius of 14 cm.
Rajah 4 menunjukkan semibulatan OPQR berpusat O dan berjejari 10 cm. *PST ialah sebuah sektor bulatan berpusat S dan berjejari* 14 cm.

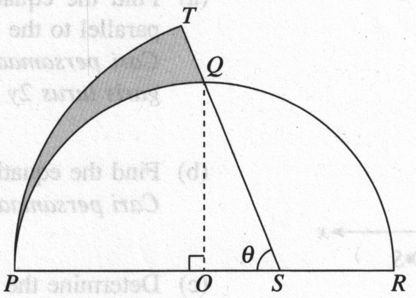

Diagram 4/*Rajah* 4

[Use/*Guna* $\pi = 3.142$]

(a) Find the value of θ, in radians.
Cari nilai θ, *dalam radian.*

[1 *mark*/1 *markah*]

(b) Calculate the perimeter, in cm, of the shaded region.
Hitung perimeter, dalam cm, *rantau berlorek.*

[3 *marks*/3 *markah*]

(c) Calculate the area, in cm^2, of the shaded region.
Hitung luas, dalam cm^2, *rantau berlorek.*

[3 *marks*/3 *markah*]

5 Given a geometric progression where $T_3 + T_4 = \frac{400}{27}$ and $T_4 + T_5 = \frac{800}{81}$. Find
Diberi satu janjang geometri dengan keadaan $T_3 + T_4 = \frac{400}{27}$ *dan* $T_4 + T_5 = \frac{800}{81}$. *Cari*

(a) the common ratio of the geometric progression.
nisbah sepunya bagi janjang geometri itu.
[3 *marks*/3 *markah*]

(b) the sixth term.
sebutan keenam.
[2 *marks*/2 *markah*]

(c) the value of n if $T_n = \frac{1\,280}{729}$.
nilai n jika $T_n = \frac{1\,280}{729}$.
[2 *marks*/2 *markah*]

6 Solution by scale drawing is not accepted.
Penyelesaian secara lukisan berskala tidak diterima.
Diagram 6 shows a quadrilateral *PQRS* where the gradient of *PS* is –1 and it is perpendicular to *RS*.
Rajah 6 menunjukkan sisi empat PQRS dengan keadaan kecerunan PS ialah –1 dan PS berserenjang dengan RS.

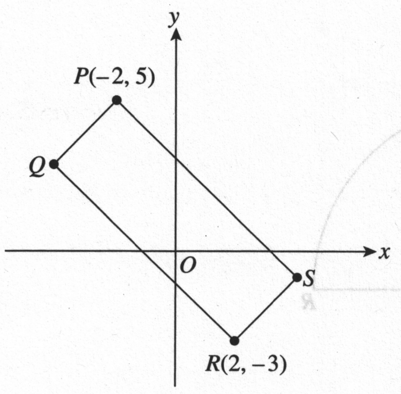

Diagram 6/*Rajah* 6

(a) Find the equation of the straight line *QS* which is parallel to the straight line $2y + x = 1$.
Cari persamaan garis lurus QS yang selari dengan garis lurus $2y + x = 1$.
[3 *marks*/3 *markah*]

(b) Find the equation of the straight line *RS*.
Cari persamaan garis lurus RS.
[1 *mark*/1 *markah*]

(c) Determine the coordinates of points *Q* and *S*. Hence, find the area of the quadrilateral *PQRS*.
Tentukan koordinat bagi titik Q dan titik S. Seterusnya, cari luas sisi empat PQRS.
[4 *marks*/4 *markah*]

7 (a) Given m and n are the roots of a quadratic equation $ax^2 + bx + c = 0$. Express in terms of m and n:
Diberi m dan n ialah punca bagi persamaan kuadratik $ax^2 + bx + c = 0$. *Ungkapkan dalam sebutan m dan n*:

(i) $\frac{c}{b}$ (ii) $\frac{a + b + c}{b}$
[4 *marks*/4 *markah*]

(b) Find the range of values of x such that the quadratic function $f(x) = 15 + 2x - x^2$ is negative.
Cari julat nilai x dengan keadaan fungsi kuadratik $f(x) = 15 + 2x - x^2$ *adalah negatif.*
[3 *marks*/3 *markah*]

Section B
Bahagian B

[30 *marks*/30 *markah*]

Answer any **three** questions from this section.
Jawab mana-mana **tiga** *soalan daripada bahagian ini.*

8 (a) Diagram 8(a) shows the curve of the function $y = x^3 - 8$.
Rajah 8(a) *menunjukkan lengkung bagi fungsi* $y = x^3 - 8$.

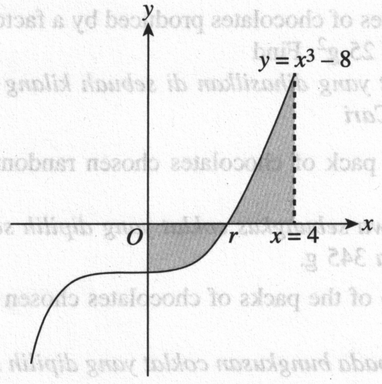

Diagram 8(a)/*Rajah* 8(a)

(i) Find the value of r.
Cari nilai r.

(ii) Calculate the area of the shaded region.
Hitung luas kawasan berlorek.

[5 *marks*/5 *markah*]

(b) Diagram 8(b) shows a curve $y = \frac{x^2}{3}$ and two straight lines, $x = 4$ and $y = q$.
Rajah 8(b) *menunjukkan lengkung* $y = \frac{x^2}{3}$ *dan dua garis lurus,* $x = 4$ *dan* $y = q$.

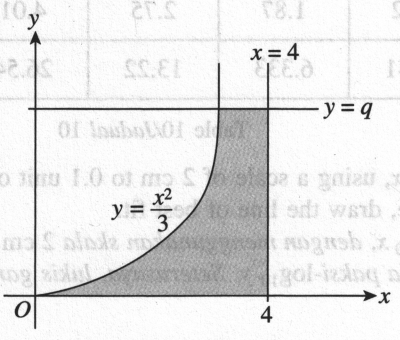

Diagram 8(b)/*Rajah* 8(b)

When the shaded region is rotated through 360° about the y-axis, the volume generated is $34\frac{1}{2}\pi$ unit^3.
If $q < 5$, find the value of q.
Apabila kawasan berlorek diputarkan melalui 360° pada paksi-y, isi padu janaan ialah $34\frac{1}{2}\pi$ *unit*^{3}.
Jika $q < 5$, *cari nilai* q.

[5 *marks*/5 *markah*]

9 (a) In a university, 60% of the students are females. If 8 students are randomly chosen, find
Di sebuah universiti, 60% daripada pelajarnya adalah pelajar perempuan. Jika 8 orang pelajar dipilih secara rawak, cari

(i) the mean and the variance of choosing a female student.
min dan varian bagi memilih seorang pelajar perempuan.

(ii) the probability that at least 3 of them are male students.
kebarangkalian bahawa sekurang-kurangnya 3 orang daripada mereka adalah pelajar lelaki.

[5 *marks*/5 *markah*]

(b) The masses of different types of chocolates produced by a factory are normally distributed with a mean of 350 g and a variance of 25 g^2. Find
Jisim pelbagai jenis coklat yang dihasilkan di sebuah kilang bertaburan secara normal dengan min 350 g *dan varians* 25 g^2. *Cari*

(i) the probability that a pack of chocolates chosen randomly from the factory has a mass of less than 345 g.
kebarangkalian bahawa sebungkus coklat yang dipilih secara rawak dari kilang itu mempunyai jisim kurang daripada 345 g.

(ii) the value of k, if 68% of the packs of chocolates chosen randomly from the factory have a mass of more than k g.
nilai k, jika 68% daripada bungkusan coklat yang dipilih secara rawak dari kilang itu mempunyai jisim melebihi k g.

[5 *marks*/5 *markah*]

10 Use graph paper to answer this question.
Gunakan kertas graf untuk menjawab soalan ini.

Table 10 shows the values of two variables, x and y, obtained from an experiment. The variables x and y are related by the equation $y = px^{\frac{k}{3}}$, where p dan k are constants.
Jadual 10 *menunjukkan nilai-nilai bagi dua pemboleh ubah, x dan y, yang diperoleh daripada satu eksperimen. Pemboleh ubah x dan y dihubungkan oleh persamaan* $y = px^{\frac{k}{3}}$, *dengan keadaan p dan k ialah pemalar.*

x	1.32	1.87	2.75	4.01	5.62	8.03
y	3.141	6.333	13.22	26.54	50.55	96.22

Table 10/*Jadual* 10

(a) Plot $\log_{10} y$ against $\log_{10} x$, using a scale of 2 cm to 0.1 unit on the $\log_{10} x$-axis and 2 cm to 0.2 unit on the $\log_{10} y$-axis. Hence, draw the line of best fit.
Plot $\log_{10} y$ *melawan* $\log_{10} x$, *dengan menggunakan skala* 2 cm *kepada* 0.1 *unit pada paksi-*$\log_{10} x$ *dan* 2 cm *kepada* 0.2 *unit pada paksi-*$\log_{10} y$. *Seterusnya, lukis garis lurus penyuaian terbaik.*

[4 *marks*/4 *markah*]

(b) Using the graph in (a), find
Dengan menggunakan graf di (a), cari

(i) the values of p and k.
nilai p dan nilai k.

(ii) the value of y when $x = 2.05$.
nilai y apabila $x = 2.05$.

[6 *marks*/6 *markah*]

11 (a) Prove that $2 \cot 2A = \cot A - \tan A$.
Buktikan $2 \text{ kot } 2A = \text{kot } A - \tan A$.

[3 *marks*/3 *markah*]

(b) (i) Sketch the graph of $y = 2 \sin \frac{3}{2}x$ for $0 \leqslant x \leqslant \pi$.

Lakarkan graf bagi $y = 2 \sin \frac{3}{2}x$ *untuk* $0 \leqslant x \leqslant \pi$.

[3 *marks*/3 *markah*]

(ii) Hence, using the same axes, sketch a suitable straight line to solve the equation $\sin \frac{3}{2}x = \frac{3x}{2\pi} - \frac{1}{2}$ for $0 \leqslant x \leqslant \pi$. State the number of solutions.

Seterusnya, dengan menggunakan paksi yang sama, lakarkan satu garis lurus yang sesuai untuk menyelesaikan persamaan $\sin \frac{3}{2}x = \frac{3x}{2\pi} - \frac{1}{2}$ *untuk* $0 \leqslant x \leqslant \pi$. *Nyatakan bilangan penyelesaian itu.*

[4 *marks*/4 *markah*]

Section C
Bahagian C

[20 *marks*/20 *markah*]

Answer any **two** questions from this section.
Jawab mana-mana **dua** *soalan daripada bahagian ini.*

12 A particle moves along a straight line and passes through a fixed point O. Its velocity, v m s^{-1}, is given by $v = t^2 - 8t + 7$, where t is the time, in seconds, after passing through point O.
Suatu zarah bergerak di sepanjang satu garis lurus dan melalui satu titik tetap O. Halajunya, v m s^{-1}, *diberi oleh* $v = t^2 - 8t + 7$, *dengan keadaan t ialah masa, dalam saat, selepas melalui titik O.*

[Assume the motion to the right is positive.]
[*Anggapkan gerakan ke arah kanan sebagai positif.*]

(a) Find the initial velocity, in m s^{-1}, of the particle.
Cari halaju awal, dalam m s^{-1}, *zarah itu.*

[2 *marks*/2 *markah*]

(b) Find the values of t, in seconds, when the particle stops instantaneously.
Cari nilai t, dalam saat, apabila zarah itu berhenti seketika.

[2 *marks*/2 *markah*]

(c) Find the minimum velocity, in m s^{-1}, of the particle.
Cari halaju minimum, dalam m s^{-1}, *zarah itu.*

[3 *marks*/3 *markah*]

(d) Calculate the total distance, in m, travelled by the particle in the first 7 seconds.
Hitung jumlah jarak, dalam m, *yang dilalui oleh zarah itu dalam 7 saat pertama.*

[3 *marks*/3 *markah*]

13 Table 13 shows the information related to three commodities, *P*, *Q* and *R*. Diagram 13 is a pie chart showing the weightages of the commodities.
Jadual 13 *menunjukkan maklumat berkaitan dengan tiga jenis komoditi, P, Q dan R. Rajah* 13 *ialah carta pai yang menunjukkan pemberat bagi komoditi itu.*

Commodity ***Komoditi***	**Price index in the year 2016 based on the year 2014** ***Indeks harga pada tahun* 2016 *berasaskan tahun* 2014**	**Change in price index from the year 2016 to the year 2019** ***Perubahan indeks harga dari tahun* 2016 *ke tahun* 2019**
P	180	Increased 10% *Menokok* 10%
Q	145	No change *Tidak berubah*
R	125	Decreased 5% *Menyusut* 5%

Table 13/*Jadual* 13

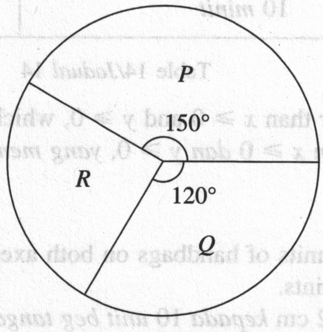

Diagram 13/*Rajah* 13

(a) Find the price index of each commodity in the year 2019 based on the year 2014.
Cari indeks harga bagi setiap komoditi pada tahun 2019 *berasaskan tahun* 2014.
[3 *marks*/3 *markah*]

(b) Find the price of commodity *Q* in the year 2014 if its price in the year 2016 is RM250.
Cari harga komoditi Q pada tahun 2014 *jika harganya pada tahun* 2016 *ialah* RM250.
[2 *marks*/2 *markah*]

(c) Find the price of commodity *R* in the year 2019 if its price in the year 2014 is RM500.
Cari harga komoditi R pada tahun 2019 *jika harganya pada tahun* 2014 *ialah* RM500.
[2 *marks*/2 *markah*]

(d) Calculate the composite index for the prices of the commodities in the year 2019 based on the year 2014.
Hitung indeks gubahan bagi harga komoditi itu pada tahun 2019 *berasaskan tahun* 2014.
[3 *marks*/3 *markah*]

14 Use graph paper to answer this question.
Gunakan kertas graf untuk menjawab soalan ini.

Table 14 shows the times taken to produce two types of high quality handbags, A and B. There are two processes, S and T, involved for producing the handbags. The time taken in a day for process S and process T are 12 hours and 8 hours respectively. Given x units of handbag A and y units of handbag B are produced in a day. The number of handbags A produced per day is at most 2 times the number of handbags B.
Jadual 14 menunjukkan masa yang diambil untuk menghasilkan dua jenis beg tangan, A dan B, yang berkualiti tinggi. Terdapat dua proses, S dan T, terlibat dalam penghasilan beg tangan itu. Masa yang diambil dalam sehari untuk proses S dan proses T masing-masing ialah 12 *jam dan* 8 *jam. Diberi x unit beg tangan A dan y unit beg tangan B dihasilkan dalam sehari. Bilangan beg tangan A yang dihasilkan dalam sehari selebih-lebihnya* 2 *kali bilangan beg tangan B.*

Handbag ***Beg tangan***	**Time taken for process *S*** ***Masa yang diambil untuk proses S***	**Time taken for process *T*** ***Masa yang diambil untuk proses T***
A	30 minutes 30 *minit*	20 minutes 20 *minit*
B	10 minutes 10 *minit*	10 minutes 10 *minit*

Table 14/*Jadual 14*

(a) Write three inequalities, other than $x \geqslant 0$ and $y \geqslant 0$, which satisfy all the above constraints.
Tulis tiga ketaksamaan, selain $x \geqslant 0$ *dan* $y \geqslant 0$, *yang memenuhi semua kekangan di atas.*

[3 marks/*3 markah*]

(b) Using a scale of 2 cm to 10 units of handbags on both axes, construct and shade the region M which satisfies all the above constraints.
Dengan menggunakan skala 2 cm *kepada* 10 *unit beg tangan pada kedua-kedua paksi, bina dan lorek rantau M yang memenuhi semua kekangan di atas.*

[3 marks/*3 markah*]

(c) Based on the graph constructed in (b), answer the following questions.
Berdasarkan graf yang dibina di (b), *jawab soalan yang berikut.*

(i) State the maximum number of handbags A that can be produced in a day.
Nyatakan bilangan maksimum beg tangan A yang dapat dihasilkan dalam sehari.

(ii) State the maximum and minimum numbers of handbags B produced in a day if 5 units of handbag A are produced in a day.
Nyatakan bilangan maksimum dan bilangan minimum beg tangan B yang dihasilkan dalam sehari jika 5 *unit beg tangan A dihasilkan dalam sehari.*

(iii) Calculate the maximum production cost required per day if the cost for a unit of handbag A and a unit of handbag B are RM500 and RM600 respectively.
Hitung kos penghasilan maksimum yang diperlukan sehari jika kos bagi seunit beg tangan A dan seunit beg tangan B masing-masing ialah RM500 *dan* RM600.

[4 marks/*4 markah*]

15 Diagram 15 shows a triangle ABC, where $\angle ABC = 30°$, $AB = 9.5$ cm and with an area of 28 cm^2.
Rajah 15 *menunjukkan segi tiga ABC, dengan* $\angle ABC = 30°$, $AB = 9.5$ cm *dan luasnya ialah* 28 cm^2.

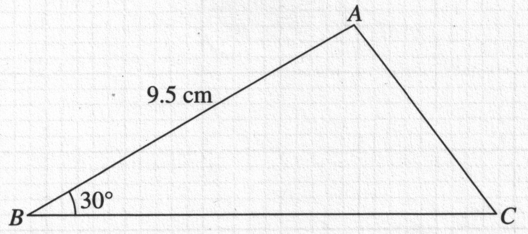

Diagram 15/*Rajah* 15

(a) Calculate the lengths, in cm, of BC and AC.
Hitung panjang, dalam cm, *bagi BC dan AC.*

[3 *marks*/3 *markah*]

(b) Find $\angle ACB$, in degrees.
Cari $\angle ACB$, *dalam darjah.*

[2 *marks*/2 *markah*]

(c) A point C' lies on BC such that $AC = AC'$.
Satu titik C' *terletak pada BC dengan keadaan* $AC = AC'$.

(i) Sketch the triangle ABC', where the length of AB and $\angle ABC$ are remain unchanged.
Lakarkan segi tiga ABC', *dengan keadaan panjang AB dan* $\angle ABC$ *tidak berubah.*

(ii) Hence, calculate the area, in cm^2, of triangle ABC'.
Seterusnya, hitung luas, dalam cm^2, *segi tiga* ABC'.

[5 *marks*/5 *markah*]

END OF QUESTION PAPER
KERTAS PEPERIKSAAN TAMAT

NO. KAD PENGENALAN | | | | | | - | | - | | | | |

ANGKA GILIRAN | | | | | | | | | |

KERTAS MODEL 2

MODEL SIJIL PELAJARAN MALAYSIA

ADDITIONAL MATHEMATICS 3472/1

Kertas 1

2 jam **Dua jam**

1. Kertas peperiksaan ini adalah dalam dwibahasa.
2. Soalan dalam bahasa Inggeris mendahului soalan yang sepadan dalam bahasa Melayu.

INFORMATION FOR CANDIDATES
MAKLUMAT UNTUK CALON

1. This question paper consists of **15** questions.
   Kertas peperiksaan ini mengandungi **15** *soalan.*
2. Answer **all** the questions in **Section A** and any **two** questions from **Section B**.
   Jawab **semua** *soalan dalam* **Bahagian A** *dan mana-mana* **dua** *soalan daripada* **Bahagian B**.
3. Write your answers in the spaces provided in the question paper.
   Tulis jawapan anda dalam ruang yang disediakan dalam kertas peperiksaan.
4. Show your working. It may help you to get marks.
   Tunjukkan langkah-langkah penting dalam kerja mengira anda. Ini boleh membantu anda mendapatkan markah.
5. The diagrams provided in the questions are not drawn to scale unless stated.
   Rajah yang mengiringi soalan tidak dilukis mengikut skala kecuali dinyatakan.
6. You may use a scientific calculator.
   Anda dibenarkan menggunakan kalkulator saintifik.

Untuk Kegunaan Pemeriksa			
Kod Pemeriksa:			
Bahagian	**Soalan**	**Markah Penuh**	**Markah Diperoleh**
A	1	6	
	2	5	
	3	5	
	4	6	
	5	4	
	6	5	
	7	5	
	8	7	
	9	6	
	10	6	
	11	5	
	12	4	
B	13	8	
	14	8	
	15	8	
Jumlah		**80**	

Section A
Bahagian A

[64 *marks*/64 *markah*]

Answer **all** the questions.
Jawab **semua** *soalan.*

1 (a) Diagram 1 shows a function f maps set P to set Q and a function g maps set Q to R.
Rajah 1 menunjukkan fungsi f memetakan set P kepada set Q dan fungsi g memetakan set Q kepada set R.

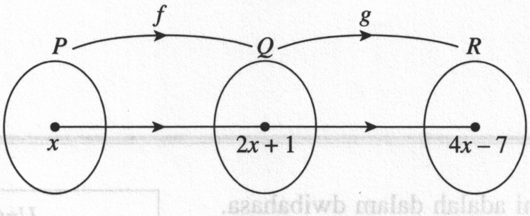

Diagram 1/*Rajah* 1

Find
Cari

(i) $f^{-1}(x)$.

(ii) $g(x)$.

[3 *marks*/3 *markah*]

(b) Given that $f(x) = |x + 3|$, find
Diberi $f(x) = |x + 3|$, *cari*

(i) the image of –4 under f.
imej bagi –4 *di bawah f.*

(ii) the possible values of x when their image is 2.
nilai-nilai x yang mungkin apabila imejnya ialah 2.

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)

(i) $f^{-1}(x)$

$f(x) = 2x+1$

let y

$2x+1 = y$

$2x = y-1$

$x = \frac{y-1}{2}$

$f^{-1}(y) = \frac{y-1}{2}$

$f^{-1}(x) = \frac{x-1}{2}$

(b)

(ii) $g(2x+1) = 4x-7$

$gf(x) = 4x-7$

$gff^{-1}(x) = 4\left(\frac{x-1}{2}\right) - 7$

$= 2(x-1) - 7$

$= 2x-2-7$

$g(x) = 2x-9$

(b) $f(x) = |x+3|$ imej bagi -4

$f(-4) = |(-4+3)|$

$f(-4) = |-1|$

$f(-4) = 1$

2 A quadratic function is given as $f(x) = (x + 2)(x + 3)$.
Suatu fungsi kuadratik diberi sebagai $f(x) = (x + 2)(x + 3)$.

(a) Express the quadratic function in the vertex form.
Ungkapkan fungsi kuadratik itu dalam bentuk verteks.

[3 marks/*3 markah*]

(b) Find the discriminant and determine the type of roots when $f(x) = 0$.
Cari pembezalayan dan tentukan jenis punca apabila $f(x) = 0$.

[2 marks/*2 markah*]

Answer/*Jawapan*:

(a)

$= x^2 + 3x + 2x + 6$

$= x^2 + 5x + 6$

$= x^2 + 5x + \left(\frac{5}{2}\right)^2 - \left(\frac{5}{2}\right)^2 + 6$

$= \left(x + \frac{5}{2}\right)^2 - \frac{1}{4}$

(b)

$x^2 + 5x + 6$

$b^2 - 4ac$

$= (5)^2 - 4(1)(6)$

$1 (> 0)$

dua punca nyata dan berbeza

the equation $f(x) = 0$ has two different real roots.

---

3 It is given that …, p, –255, –271, –287, q, … are five consecutive terms of an arithmetic progression.
Diberi bahawa …, p, –255, –271, –287, q, … ialah lima sebutan berturutan bagi suatu janjang aritmetik.

(a) Find the values of p and q.
Cari nilai p dan nilai q.

[2 marks/*2 markah*]

(b) Hence, find $T_7 + T_{10}$ of the progression if $a = p$.
Seterusnya, cari $T_7 + T_{10}$ bagi janjang itu jika $a = p$.

[3 marks/*3 markah*]

Answer/*Jawapan*:

(a)

(b)

4 (a) Given that ${}^{n}P_{r} = {}^{n-2}P_{r}$, express n in terms of r.
Diberi ${}^{n}P_{r} = {}^{n-2}P_{r}$, *ungkapkan n dalam sebutan r.*

[3 *marks*/3 *markah*]

(b) Diagram 4 shows eight letter cards.
Rajah 4 menunjukkan lapan keping kad huruf.

P	A	N	D	E	M	I	C

Diagram 4/*Rajah 4*

Calculate the number of different ways
Hitung bilangan cara yang berlainan

(i) to arrange all the letter cards in a row.
untuk menyusun semua kad huruf itu dalam satu baris.

(ii) to choose five letter cards which consist of 2 vowels.
untuk memilih lima keping kad huruf yang terdiri daripada 2 vokal.

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

5 Given one of the roots of a quadratic equation $x^2 + 12x + m = 0$ is twice of the other root. Find the value of m and the roots.
Diberi bahawa satu daripada punca bagi persamaan kuadratik $x^2 + 12x + m = 0$ *adalah dua kali punca yang satu lagi. Cari nilai m dan punca-punca itu.*

[4 *marks*/4 *markah*]

Answer/*Jawapan*:

SORBA PORCA

$x^2+12x+m=0$

$-\frac{b}{a}$ $\quad \frac{c}{a}$

SOR : $\alpha+\beta = -\frac{b}{a}$

$= -\frac{(12)}{m}$

$\alpha+\beta = -\frac{12}{m}$

POR = $\alpha\beta = \frac{m}{1}$

$\alpha\beta = m$

$2\left(-\frac{12}{m}\right) = m$

$-\frac{24}{m} = m$

$-24 = m^2$

$\sqrt{-24} = m$

6 (a) Show that $3^{m+4} + 3^m - 45(3^{m-2})$ is divisible by 11 for all the positive integers of *m*.
Tunjukkan bahawa $3^{m+4} + 3^m - 45(3^{m-2})$ *boleh dibahagi tepat dengan* 11 *bagi semua integer positif m.*

[3 *marks*/3 *markah*]

(b) Simplify: $\dfrac{7+\sqrt{5}}{7-\sqrt{5}}$
Permudahkan:

[2 *marks*/2 *markah*]

Answer/*Jawapan*:

(a)

(b)

---

7 The gradient function of a curve is $3x^2 + 5$ and the point (2, 6) lies on the curve. Find
Fungsi kecerunan bagi suatu lengkung ialah $3x^2 + 5$ *dan titik* (2, 6) *terletak pada lengkung itu. Cari*

(a) the equation of the curve.
persamaan bagi lengkung itu.

[3 *marks*/3 *markah*]

(b) the equation of the tangent to the curve at point (2, 6).
persamaan tangen kepada lengkung itu pada titik (2, 6).

[2 *marks*/2 *markah*]

Answer/*Jawapan*:

(a)

(b)

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8 Diagram 8 shows a circle *RST* with centre *O* and a radius of 8 cm. *PRQ* is a quadrant with centre *R*, where *R* is the midpoint of *OQ*. *PR* is a tangent to the circle at point *R*. *ORQ* and *POS* are straight lines.
Rajah 8 menunjukkan bulatan RST yang berpusat O dan berjejari 8 cm. *PRQ ialah satu sukuan bulatan berpusat R, di mana R ialah titik tengah OQ. PR ialah tangen kepada bulatan itu pada titik R. ORQ dan POS ialah garis lurus.*

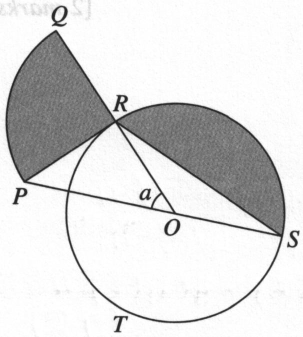

Diagram 8/*Rajah* 8

[Use/*Guna* $\pi = 3.142$]

(a) Find the value of a, in radian.
Cari nilai a, dalam radian.
[2 *marks*/2 *markah*]

(b) Calculate the total perimeter, in cm, of the shaded regions.
Hitung jumlah perimeter, dalam cm, *kawasan berlorek.*
[3 *marks*/3 *markah*]

(c) Calculate the total area, in cm^2, of the shaded regions.
Hitung jumlah luas, dalam cm^2, *kawasan berlorek.*
[2 *marks*/2 *markah*]

Answer/*Jawapan*:

(a)

(b)

(c)

9 (a) Given a point A is the y-intercept of a curve $y = 2x^2 - 8x + 1$. Find
Diberi titik A ialah pintasan-y bagi lengkung $y = 2x^2 - 8x + 1$. Cari

(i) the gradient of the tangent to the curve at point A.
kecerunan tangen kepada lengkung itu di titik A.

(ii) the equation of the normal to the curve at point A.
persamaan normal kepada lengkung itu di titik A.

[3 *marks*/3 *markah*]

(b) Given that $\int_2^8 \frac{ax^5 + 8x^2}{x^4} \, dx = 2a - 5$, where a is a constant. Find the value of a.

Diberi $\int_2^8 \frac{ax^5 + 8x^2}{x^4} \, dx = 2a - 5$, dengan keadaan a ialah pemalar. Cari nilai a.

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

10 (a)

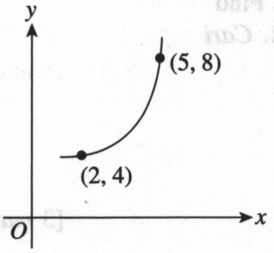

Diagram 10(a)/*Rajah* 10(a)

Diagram 10(a) shows the curve of a function $y = \frac{12x}{5 + qx}$. Find the value of q.
Rajah 10(a) *menunjukkan graf bagi fungsi* $y = \frac{12x}{5 + qx}$. *Cari nilai q.*

[2 *marks*/2 *markah*]

(b)

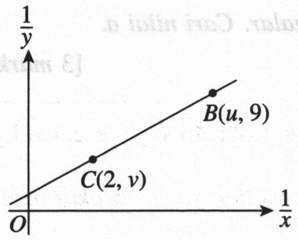

Diagram 10(b)/*Rajah* 10(b)

Diagram 10(b) shows the line of best fit obtained when the function $y = \frac{12x}{5 + qx}$ is reduced to a linear form. Find the values of u and v.
Rajah 10(b) *menunjukkan garis lurus penyuaian terbaik yang diperoleh apabila fungsi* $y = \frac{12x}{5 + qx}$ *ditukar kepada bentuk linear. Cari nilai u dan nilai v.*

[4 *marks*/4 *markah*]

Answer/*Jawapan*:
(a)

(b)

11 Given that $\log_x 3 = a$ and $\log_x 5 = b$, express $\log_{\sqrt{x}} 405x^2$ in terms of a and b.
Diberi $\log_x 3 = a$ *dan* $\log_x 5 = b$, *ungkapkan* $\log_{\sqrt{x}} 405x^2$ *dalam sebutan a dan b.*

[5 *marks*/5 *markah*]

Answer/*Jawapan*:

---

12 Diagram 12 shows the graph of a standard normal distribution. The probability represented by the area of the shaded region is 0.17.
Rajah 12 *menunjukkan satu graf taburan normal piawai. Kebarangkalian yang diwakili oleh luas rantau berlorek ialah* 0.17.

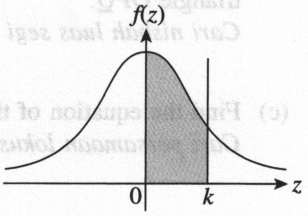

Diagram 12/*Rajah* 12

(a) Find the value of k.
Cari nilai k.

[2 *marks*/2 *markah*]

(b) Given X is a continuous random variable which is normally distributed with a mean of μ and a standard deviation of 3. Find the value of μ if $X = 60$ when the z-score is k.
Diberi X ialah pemboleh ubah rawak selanjar yang bertaburan secara normal dengan min μ *dan sisihan piawai* 3. *Cari nilai* μ *jika* $X = 60$ *apabila skor-z ialah k.*

[2 *marks*/2 *markah*]

Answer/*Jawapan*:
(a) (b)

Section B
Bahagian B

[16 *marks*/16 *markah*]

Answer any **two** questions.
Jawab mana-mana **dua** *soalan.*

13 Diagram 13 shows a triangle *PQR*. A point *S* moves such that its distances from point *P* and point *Q* are in the ratio 1 : 2.
Rajah 13 menunjukkan segi tiga PQR. Satu titik S bergerak dengan keadaan jaraknya dari titik P dan titik Q adalah dalam nisbah 1 : 2.

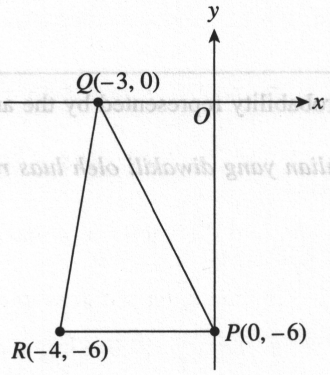

Diagram 13/*Rajah* 13

(a) Find the equation of the straight line that passes through point *R* and is perpendicular to *PQ*.
Cari persamaan garis lurus yang melalui titik R dan berserenjang dengan PQ.
[2 *marks*/2 *markah*]

(b) Find the ratio of the area of triangle *PQR* to the area of triangle *OPQ*.
Cari nisbah luas segi tiga PQR kepada luas segi tiga OPQ.
[3 *marks*/3 *markah*]

(c) Find the equation of the locus of point *S*.
Cari persamaan lokus bagi titik S.
[3 *marks*/3 *markah*]

Answer/*Jawapan*:
(a)

(b)

(c)

14 (a) Diagram 14(a) shows a vector $\overrightarrow{AB}$ drawn on a Cartesian plane.
Rajah 14(a) *menunjukkan vektor* $\overrightarrow{AB}$ *yang dilukis pada satu satah Cartes.*

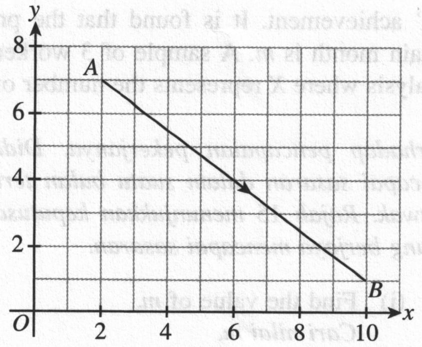

Diagram 14(a)/*Rajah* 14(a)

(i) Express $\overrightarrow{AB}$ in the form $\begin{pmatrix} x \\ y \end{pmatrix}$.
Ungkapkan $\overrightarrow{AB}$ *dalam bentuk* $\begin{pmatrix} x \\ y \end{pmatrix}$.

(ii) Find the magnitude of $\overrightarrow{AB}$.
Cari magnitud $\overrightarrow{AB}$.

[3 *marks*/3 *markah*]

(b) Diagram 14(b) shows a quadrilateral *ABCD*. Given $\overrightarrow{AB} = q\mathbf{a}$, $\overrightarrow{BC} = q\mathbf{b}$ and $\overrightarrow{DC} = p\mathbf{a}$, where p and q are constants.
Rajah 14(b) *menunjukkan sisi empat ABCD. Diberi* $\overrightarrow{AB} = q\mathbf{a}$, $\overrightarrow{BC} = q\mathbf{b}$ *dan* $\overrightarrow{DC} = p\mathbf{a}$, *dengan keadaan p dan q ialah pemalar.*

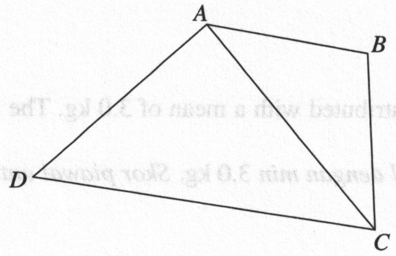

Diagram 14(b)/*Rajah* 14(b)

(i) If $\overrightarrow{AD} = -5\mathbf{a} + \left(\frac{p+3}{2}\right)\mathbf{b}$, find the values of p and q.

Jika $\overrightarrow{AD} = -5\mathbf{a} + \left(\frac{p+3}{2}\right)\mathbf{b}$, *cari nilai p dan nilai q.*

[3 *marks*/3 *markah*]

(ii) Given the area of triangle *ACD* is 52 unit^2 and the perpendicular distance from *A* to *CD* is 4 units. Find the value of $|\mathbf{a}|$.
Diberi luas segi tiga ACD ialah 52 unit^2 *dan jarak serenjang dari A ke CD ialah 4 unit. Cari nilai* $|\mathbf{a}|$.

[2 *marks*/2 *markah*]

Answer/*Jawapan*:
(a)

(b)

15 (a) A factory conducts an analysis on the workers' achievement. It is found that the probability of a worker successfully achieves the target in a certain month is m. A sample of 3 workers is randomly selected. Diagram 15 shows the results of the analysis where X represents the number of workers who has achieved the target.
Sebuah kilang menjalankan satu analisis terhadap pencapaian pekerjanya. Didapati bahawa kebarangkalian seseorang pekerja berjaya mencapai sasaran dalam suatu bulan tertentu ialah m. Satu sampel 3 orang pekerja dipilih secara rawak. Rajah 15 menunjukkan keputusan analisis itu dengan keadaan X mewakili bilangan pekerja yang berjaya mencapai sasaran.

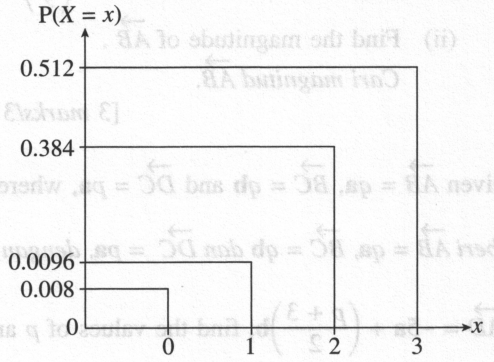

Diagram 15/*Rajah* 15

(i) Find the value of m.
Cari nilai m.
[2 marks/*2 markah*]

(ii) If the factory has 75 workers, find the number of workers who are not achieving the target.
Jika kilang itu mempunyai 75 orang pekerja, cari bilangan pekerja yang tidak mencapai sasaran.
[2 marks/*2 markah*]

(b) The masses of the watermelons in a farm are normally distributed with a mean of 3.0 kg. The standard score for a watermelon with mass 2.8 kg is –0.4.
Jisim tembikai di sebuah kebun bertaburan secara normal dengan min 3.0 kg. *Skor piawai untuk sebiji tembikai berjisim* 2.8 kg *ialah* –0.4.

(i) Find the variance.
Cari nilai varians.
[2 marks/*2 markah*]

(ii) If 360 out of 600 watermelons have masses greater than n kg, find the value of n.
Jika 360 *daripada* 600 *biji tembikai mempunyai jisim melebihi n* kg, *cari nilai n.*
[2 marks/*2 markah*]

Answer/*Jawapan*:

(a)

(b)

END OF QUESTION PAPER
KERTAS PEPERIKSAAN TAMAT

KERTAS MODEL 2

MODEL SIJIL PELAJARAN MALAYSIA

ADDITIONAL MATHEMATICS 3472/2

Kertas 2

2 jam 30 minit **Dua jam tiga puluh minit**

1. Kertas peperiksaan ini adalah dalam dwibahasa.
2. Soalan dalam bahasa Inggeris mendahului soalan yang sepadan dalam bahasa Melayu.

INFORMATION FOR CANDIDATES
MAKLUMAT UNTUK CALON

1. This question paper consists of three sections: **Section A**, **Section B** and **Section C**.
Kertas peperiksaan ini mengandungi tiga bahagian: ***Bahagian*** **A**, ***Bahagian*** **B** *dan* ***Bahagian*** **C**.
2. Answer **all** the questions in **Section A**, any **three** questions from **Section B** and any **two** questions from **Section C**.
Jawab **semua** *soalan dalam* ***Bahagian*** **A**, *mana-mana* **tiga** *soalan daripada* ***Bahagian*** **B** *dan mana-mana* **dua** *soalan daripada* ***Bahagian*** **C**.
3. Show your working. It may help you to get marks.
Tunjukkan langkah-langkah penting dalam kerja mengira anda. Ini boleh membantu anda mendapatkan markah.
4. The diagrams provided in the questions are not drawn to scale unless stated.
Rajah yang mengiringi soalan tidak dilukis mengikut skala kecuali dinyatakan.
5. You may use a scientific calculator.
Anda dibenarkan menggunakan kalkulator saintifik.

Section A
Bahagian A

[50 *marks*/50 *markah*]

Answer **all** the questions in this section.
Jawab **semua** *soalan dalam bahagian ini.*

1 A bakery bakes three types of cakes, with the monthly cost being RM7 750 for 245 cakes. The costs for baking a banana cake, a carrot cake and a chocolate cake are RM20, RM30 and RM40 respectively. The selling prices of a banana cake, a carrot cake and a chocolate cake are RM25, RM35 and RM50 respectively. If the bakery intends to make a profit of RM1 725 monthly, how many cakes of each type should be bake?
Sebuah bakeri membuat tiga jenis kek dengan kos bulanan ialah RM7 750 *untuk* 245 *biji kek. Kos untuk membuat sebiji kek pisang, sebiji kek lobak merah dan sebiji kek coklat masing-masing ialah* RM20, RM30 *dan* RM40. *Harga jualan bagi sebiji kek pisang, sebiji kek lobak merah dan sebiji kek coklat masing-masing ialah* RM25, RM35 *dan* RM50. *Jika bakeri itu ingin memperoleh keuntungan sebanyak* RM1 725 *setiap bulan, berapakah bilangan setiap jenis kek yang perlu dibuat*?

[6 *marks*/6 *markah*]

2 A company offers two schemes of salary payment to its employees.
Sebuah syarikat menawarkan dua skim pembayaran gaji kepada pekerjanya.

Scheme I : Initial salary of RM1 500 per month with an annual increment of RM250.
Skim I : *Gaji permulaan* RM1 500 *sebulan dengan kenaikan gaji tahunan sebanyak* RM250.

Scheme II : Initial salary of RM20 000 per annum with an annual increment of 2% from the basic salary.
Skim II : *Gaji permulaan* RM20 000 *setahun dengan kenaikan gaji tahunan sebanyak* 2% *daripada gaji pokok.*

(a) Farhan decides to choose the scheme which offers a higher income and saves 30% of his total salary to buy a house after working for 10 years. Which scheme should Farhan choose and how much is his savings for his house? Round off the answer to the nearest RM.
Farhan bercadang untuk memilih skim yang menawarkan pendapatan yang lebih tinggi dan menabung 30% *daripada jumlah gajinya untuk membeli sebuah rumah selepas bekerja selama* 10 *tahun. Skim manakah yang patut Farhan pilih dan berapakah tabungannya untuk membeli rumahnya? Bundarkan jawapan kepada* RM *terdekat.*

[4 *marks*/4 *markah*]

(b) At the beginning of the 7th year, the annual increment changes from RM250 to RM300 for Scheme I. Calculate the monthly salary of Farhan for the 10th year.
*Pada awal tahun ke-*7, *kenaikan gaji tahunan telah berubah daripada* RM250 *kepada* RM300 *untuk Skim* I. *Hitung gaji bulanan Farhan untuk tahun ke-*10.

[3 *marks*/3 *markah*]

3 (a) Prove that:
Buktikan:
$$\tan 3x = \frac{3\tan x - \tan^3 x}{1 - 3\tan^2 x}$$
[2 *marks*/2 *markah*]

(b) (i) Sketch the graph of $y = 1 - \tan 3x$ for $0 \leqslant x \leqslant \pi$.
Lakarkan graf bagi $y = 1 - \tan 3x$ *untuk* $0 \leqslant x \leqslant \pi$.
[3 *marks*/3 *markah*]

(ii) Hence, using the same axes, sketch a suitable straight line to find the solutions to the equation $\frac{2x}{\pi} + \frac{3\tan x - \tan^3 x}{1 - 3\tan^2 x} = 0$ for $0 \leqslant x \leqslant \pi$. State the number of solutions.
Seterusnya, dengan menggunakan paksi yang sama, lakar satu garis lurus yang sesuai untuk mencari penyelesaian bagi persamaan $\frac{2x}{\pi} + \frac{3\tan x - \tan^3 x}{1 - 3\tan^2 x} = 0$ *untuk* $0 \leqslant x \leqslant \pi$. *Nyatakan bilangan penyelesaian itu.*
[3 *marks*/3 *markah*]

4 In Diagram 4, *ABCD* is a rectangle. *OAED* is a sector of a circle with centre *O* and a radius of 8 cm. Given *O* is the midpoint of *AC* and $\angle CAB = 40°$.
Dalam Rajah 4, ABCD ialah sebuah segi empat tepat. OAED ialah sebuah sektor bulatan berpusat O dan berjejari 8 cm. *Diberi O ialah titik tengah AC dan* $\angle CAB = 40°$.

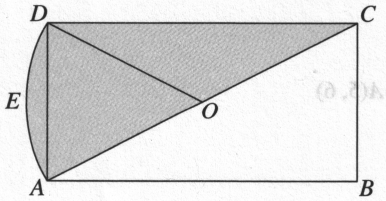

Diagram 4/*Rajah* 4

[Use/*Guna* $\pi = 3.142$]

(a) Find $\angle AOD$, in radians.
Cari $\angle AOD$, *dalam radian.*
[2 *marks*/2 *markah*]

(b) Calculate the perimeter, in cm, of the shaded region.
Hitung perimeter, dalam cm, *kawasan berlorek.*
[3 *marks*/3 *markah*]

(c) Calculate the area, in cm^2, of the shaded region.
Hitung luas, dalam cm^2, *kawasan berlorek.*
[3 *marks*/3 *markah*]

5 (a) Show that $x = 1$ is a solution to the equation $2^{3x} - 4x \cdot 2^x + 2^x - 2 = 0$.
Tunjukkan bahawa $x = 1$ *ialah penyelesaian bagi* $2^{3x} - 4x \cdot 2^x + 2^x - 2 = 0$.
[2 *marks*/2 *markah*]

(b) It is given that $\log_3 x = p$ and $\log_9 y = q$. Find the values of p and q if $xy^2 = 81$ and $\frac{x^2}{y} = \frac{1}{3}$.
Diberi bahawa $\log_3 x = p$ *dan* $\log_9 y = q$. *Cari nilai p dan nilai q jika* $xy^2 = 81$ *dan* $\frac{x^2}{y} = \frac{1}{3}$.
[6 *marks*/6 *markah*]

6 Diagram 6 shows a curve which has a gradient function of $2x - 7$. The curve passes through point $A(5, 0)$ and intersects the straight line $y = 2x + 2$ at point $B(h, 4)$.
Rajah 6 menunjukkan satu lengkung yang mempunyai fungsi kecerunan $2x - 7$. Lengkung itu melalui titik $A(5, 0)$ dan bersilang dengan garis lurus $y = 2x + 2$ di titik $B(h, 4)$.

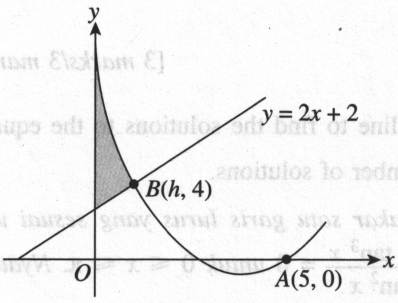

Diagram 6/*Rajah 6*

(a) Determine the equation of the curve.
Tentukan persamaan lengkung itu.

[2 marks/*2 markah*]

(b) Find the value of h.
Cari nilai h.

[2 marks/*2 markah*]

(c) Calculate the area of the shaded region.
Hitung luas rantau berlorek.

[3 marks/*3 markah*]

7 Solution by scale drawing is not accepted.
Penyelesaian secara lukisan berskala tidak diterima.
Diagram 7 shows an herbs garden at SMK Cemerlang. *BD* is a reflexology path in the garden.
Rajah 7 menunjukkan sebuah taman herba di SMK Cemerlang. BD ialah sebuah laluan refleksologi dalam taman itu.

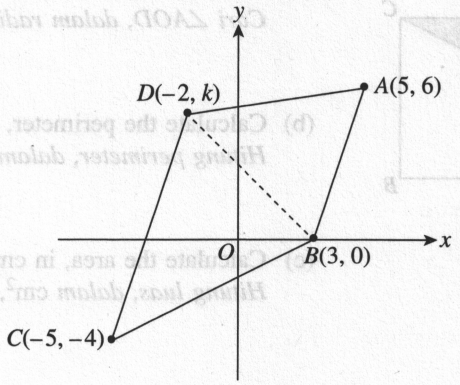

Diagram 7/*Rajah 7*

Another straight reflexology path is to be built to join point *A* to path *BD* at a point $P(h, 2h)$. The length of *AP* is $\sqrt{32}$ m.
Sebuah lagi laluan refleksologi yang lurus akan dibina untuk menghubungkan titik A ke laluan BD pada titik $P(h, 2h)$. Panjang AP ialah $\sqrt{32}$ m.

(a) Find the values of h and k.
Cari nilai h dan nilai k.

[4 marks/*4 markah*]

(b) Hence, determine whether *AP* is the shortest distance from point *A* to path *BD*.
Seterusnya, tentukan sama ada AP adalah jarak terpendek dari titik A ke BD atau tidak.

[2 marks/*2 markah*]

Section B
Bahagian B

[30 *marks*/30 *markah*]

Answer any **three** questionss from this section.
Jawab mana-mana **tiga** *soalan daripada bahagian ini.*

8 Diagram 8 shows a parallelogram *ABCD*. Point *J* lies on the straight line *AB* and point *K* lies on the straight line *DC*. The straight line *AK* is extended to a point *L* such that $3AK = 2AL$. It is given that:
Rajah 8 menunjukkan segi empat selari ABCD. Titik J terletak pada garis lurus AB dan titik K terletak pada garis lurus DC. Garis lurus AK dipanjangkan ke titik L dengan keadaan $3AK = 2AL$*. Diberi bahawa:*

$$AJ : JB = 3 : 1\ ,\ DK : KC = 3 : 1\ ,\ \overrightarrow{AB} = 8\mathbf{p}\ ,\ \overrightarrow{AD} = \mathbf{q}$$

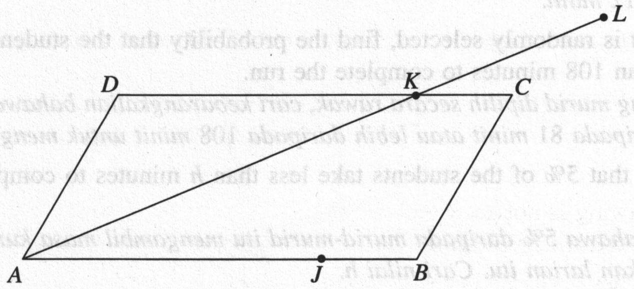

Diagram 8/*Rajah 8*

(a) Express $\overrightarrow{AK}$ and $\overrightarrow{JC}$ in terms of **p** and **q**.
Ungkapkan $\overrightarrow{AK}$ *dan* $\overrightarrow{JC}$ *dalam sebutan* **p** *dan* **q**.

[3 *marks*/3 *markah*]

(b) Hence, show that the points *J*, *C* and *L* are collinear.
Seterusnya, tunjukkan bahawa titik J, C dan L adalah segaris.

[3 *marks*/3 *markah*]

(c) It is given that $\mathbf{p} = 3\mathbf{i}$ and $\mathbf{q} = 2\mathbf{i} + 5\mathbf{j}$.
Diberi bahawa $\mathbf{p} = 3\mathbf{i}$ *dan* $\mathbf{q} = 2\mathbf{i} + 5\mathbf{j}$.

(i) Express $\overrightarrow{JC}$ in terms of **i** and **j**.
Ungkapkan $\overrightarrow{JC}$ *dalam sebutan* **i** *dan* **j**.

(ii) Find the unit vector in the direction of $\overrightarrow{JC}$.
Cari vektor unit dalam arah $\overrightarrow{JC}$.

[4 *marks*/4 *markah*]

9 (a) A box contains two types of oranges, A and B, in the ratio of 5 : 3. If 8 oranges are picked at random from the box, find the probability that
Sebuah kotak mengandungi dua jenis oren, A dan B, dengan nisbah 5 : 3. *Jika* 8 *biji oren dipilih secara rawak daripada kotak itu, cari kebarangkalian bahawa*

(i) 7 oranges of type A are picked.
7 biji oren jenis A dipilih.

(ii) at least 2 oranges of type B are picked.
sekurang-kurangnya 2 biji oren jenis B dipilih.

[5 *marks*/5 *markah*]

(b) During a cross-country running event, the time taken by the students to run from the starting point to the finishing line follow a normal distribution with a mean of 90 minutes and a standard deviation of 12 minutes.
Semasa acara larian merentas desa, masa yang diambil oleh murid-murid untuk berlari daripada garisan permulaan hingga ke garisan penamat mengikut taburan normal dengan min 90 *minit dan sisihan piawai* 12 *minit.*

(i) If a student is randomly selected, find the probability that the student takes less than 81 minutes or more than 108 minutes to complete the run.
Jika seorang murid dipilih secara rawak, cari kebarangkalian bahawa murid itu mengambil masa kurang daripada 81 *minit atau lebih daripada* 108 *minit untuk menghabiskan larian itu.*

(ii) It is found that 5% of the students take less than h minutes to complete the run. Find the value of h.
Didapati bahawa 5% daripada murid-murid itu mengambil masa kurang daripada h minit untuk menghabiskan larian itu. Cari nilai h.

[5 *marks*/5 *markah*]

10 Use graph paper to answer this question.
Gunakan kertas graf untuk menjawab soalan ini.

Table 10 shows the values of two variables, x and y, obtained from an experiment. The variables x and y are related by the equation $y = 2mx + \frac{n}{5x}$, where m and n are constants.
Jadual 10 *menunjukkan nilai-nilai bagi dua pemboleh ubah, x dan y, yang diperoleh daripada satu eksperimen. Pemboleh ubah x dan y dihubungkan oleh persamaan* $y = 2mx + \frac{n}{5x}$, *dengan keadaan m dan n ialah pemalar.*

x	1	2	3	4	5	5.5
y	3.10	2.30	2.33	2.35	2.72	2.89

Table 10/*Jadual* 10

(a) Plot xy against x^2, using a scale of 2 cm to 5 units on the x^2-axis and 2 cm to 2 units on the xy-axis. Hence, draw the line of best fit.
Plot xy melawan x^2, *dengan menggunakan skala* 2 cm *kepada* 5 *unit pada paksi-*x^2 *dan* 2 cm *kepada* 2 *unit pada paksi-xy. Seterusnya, lukis garis lurus penyuaian terbaik.*

[5 *marks*/5 *markah*]

(b) Using the graph in (a), find
Dengan menggunakan graf di (a), *cari*

(i) the value of m.
nilai m.

(ii) the value of n.
nilai n.

(iii) the value of y when $x = 4.5$.
nilai y apabila $x = 4.5$.

[5 *marks*/5 *markah*]

11 Diagram 11 shows a solid consisting of a hemisphere on top of an enclosed cylinder with a radius of r cm and a height of h cm.
Rajah 11 menunjukkan sebuah pepejal yang terdiri daripada sebuah hemisfera yang terletak di atas sebuah silinder tertutup berjejari r cm dan tinggi h cm.

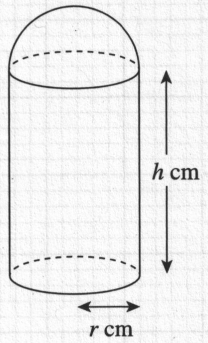

Diagram 11/*Rajah* 11

[Volume of a sphere = $\frac{4}{3}\pi r^3$; Surface area of a sphere = $4\pi r^2$]

[*Isi padu sfera* = $\frac{4}{3}\pi r^3$; *Luas permukaan sfera* = $4\pi r^2$]

(a) Express the total surface area, A cm^2, and the volume, V cm^3, of the solid in terms of h and r.
Ungkapkan jumlah luas permukaan, A cm^2, *dan isi padu, V* cm^3, *pepejal itu dalam sebutan h dan r.*

[3 *marks*/3 *markah*]

(b) The total surface area of the solid is 20π cm^2. Express h in terms of r and hence, show that:
Jumlah luas permukaan pepejal itu ialah 20π cm^2. *Ungkapkan h dalam sebutan r dan seterusnya, tunjukkan bahawa*:

$$V = 10\pi r - \frac{5\pi r^3}{6}$$

[4 *marks*/4 *markah*]

(c) The radius of the solid is increasing at a rate of 0.4 cm s^{-1}. Calculate the rate of change in the volume, in cm^3 s^{-1}, when its radius is 1.5 cm.
Jejari pepejal itu bertambah pada kadar 0.4 cm s^{-1}. *Hitung kadar perubahan dalam isi padu, dalam* cm^3 s^{-1}, *apabila jejarinya ialah* 1.5 cm.

[3 *marks*/3 *markah*]

Section C
Bahagian C

[20 *marks*/20 *markah*]

Answer any **two** questionss from this section.
Jawab mana-mana **dua** *soalan daripada bahagian ini.*

12 A particle moves along a straight line and passes through a fixed point O. Its velocity, v m s^{-1}, is given by $v = pt^2 - 5t$, where p is a constant and t is the time, in seconds, after passing through O. The acceleration of the particle is 15 m s^{-2} after 2 seconds passing through O.
Suatu zarah bergerak di sepanjang satu garis lurus dan melalui satu titik tetap O. Halajunya, v m s^{-1}, *diberi oleh* $v = pt^2 - 5t$, *dengan keadaan p ialah pemalar dan t ialah masa, dalam saat, selepas melalui O. Pecutan zarah itu ialah* 15 m s^{-2} *selepas* 2 *saat melalui O.*

[Assume the motion to the right is positive.]
[*Anggapkan gerakan ke arah kanan sebagai positif.*]

(a) Find the value of p.
Cari nilai p.

[3 *marks*/3 *markah*]

(b) Find the time interval, in seconds, when the velocity of the particle is decreasing.
Cari julat masa, dalam saat, apabila halaju zarah itu menyusut.

[2 *marks*/2 *markah*]

(c) Find the times, in seconds, when the particle stops instantaneously.
Cari masa, dalam saat, apabila zarah itu berhenti seketika.

[2 *marks*/2 *markah*]

(d) Calculate the total distance, in m, travelled by the particle in the first 3 seconds.
Hitung jumlah jarak, dalam m, *yang dilalui oleh zarah itu dalam 3 saat pertama.*

[3 *marks*/3 *markah*]

13 Diagram 13 shows a quadrilateral $ABCD$. BD splits the quadrilateral into triangles ABD and BCD.
Rajah 13 *menunjukkan sisi empat ABCD. BD memisahkan sisi empat itu kepada segi tiga ABD dan BCD.*

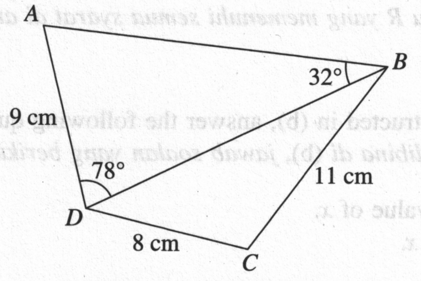

Diagram 13/*Rajah* 13

(a) Find the length of BD, in cm.
Cari panjang BD, dalam cm.

[2 *marks*/2 *markah*]

(b) Find $\angle BCD$, in degrees.
Cari $\angle BCD$, *dalam darjah.*

[2 *marks*/2 *markah*]

(c) Calculate the area, in cm^2, of the quadrilateral $ABCD$.
Hitung luas, dalam cm^2, *sisi empat ABCD.*

[3 *marks*/3 *markah*]

(d) (i) Sketch a triangle $D'B'C'$ which has a different shape from triangle DBC such that $D'C' = DC$, $D'B' = DB$ and $\angle D'B'C' = \angle DBC$.
Lakarkan sebuah segi tiga $D'B'C'$ *yang mempunyai bentuk berbeza daripada segi tiga* DBC *dengan keadaan* $D'C' = DC$, $D'B' = DB$ *dan* $\angle D'B'C' = \angle DBC$.

(ii) Hence, find the value of $\angle B'C'D'$.
Seterusnya, cari nilai $\angle B'C'D'$.

[3 *marks*/3 *markah*]

14 Use graph paper to answer this question.
Gunakan kertas graf untuk menjawab soalan ini.

Given x and y are two positive integers with the following conditions:
Diberi bahawa x dan y ialah dua integer positif dengan syarat berikut:

I : The value of x more than the value of y by 15 or more.
Nilai x melebihi nilai y sebanyak 15 *atau lebih.*

II : The minimum value of $2x + 4y$ is 40.
Nilai minimum bagi $2x + 4y$ *ialah* 40.

III : The maximum value of $2x + 4y$ is three times of its minimum value.
Nilai maksimum bagi $2x + 4y$ *adalah tiga kali nilai minimumnya.*

(a) Write an inequality for each of the above conditions.
Tulis satu ketaksamaan bagi setiap syarat di atas.

[3 *marks*/3 *markah*]

(b) Using a scale of 2 cm to 10 units on the x-axis and 2 cm to 5 units on the y-axis, construct and shade the region R that satisfies all the above conditions.
Dengan menggunakan skala 2 cm *kepada* 10 *unit pada paksi-x dan* 2 cm *kepada* 5 *unit pada paksi-y, bina dan lorekkan rantau R yang memenuhi semua syarat di atas.*

[3 *marks*/3 *markah*]

(c) Based on the graph constructed in (b), answer the following questions:
Berdasarkan graf yang dibina di (b), *jawab soalan yang berikut:*

(i) Find the minimum value of x.
Cari nilai minimum x.

(ii) Given x and y represents the number of products sold by a company. Find the maximum sales obtained by the company if the price per unit for product x and product y are RM5 and RM10 respectively.
Diberi bahawa x dan y mewakili bilangan barangan yang dijual oleh sebuah syarikat. Cari jualan maksimum yang diperoleh syarikat itu jika harga seunit barang x dan barang y masing-masing ialah RM5 *dan* RM10.

[4 *marks*/4 *markah*]

15 Table 15 shows the prices of four ingredients, E, F, G and H, used in the making of a type of dessert.
Jadual 15 menunjukkan harga bagi empat jenis bahan, E, F, G dan H, yang digunakan untuk membuat sejenis pencuci mulut.

Ingredient *Bahan*	**Price (RM) per kilogram** *Harga (RM) per kilogram*		**Weightage** *Pemberat*
	2015	**2017**	
E	4.00	w	7
F	2.50	3.50	3
G	x	y	4
H	4.00	4.80	2

Table 15/*Jadual* 15

(a) The price index of ingredient E in the year 2017 based on the year 2015 is 120. Find the value of w.
Indeks harga bagi bahan E pada tahun 2017 *berasaskan tahun* 2015 *ialah* 120. *Cari nilai w.*

[2 *marks*/2 *markah*]

(b) The price index of ingredient G in the year 2017 based on the year 2015 is 140. The price per kilogram of ingredient G in the year 2017 is RM2.00 more than its corresponding price in the year 2015. Find the values of x and y.
Indeks harga bagi bahan G pada tahun 2017 *berasaskan tahun* 2015 *ialah* 140. *Harga per kilogram bagi bahan G pada tahun* 2017 *adalah* RM2.00 *lebih daripada harga yang sepadan pada tahun* 2015. *Cari nilai x dan nilai y.*

[3 *marks*/3 *markah*]

(c) Calculate the composite index for the cost of making the dessert in the year 2017 based on the year 2015.
Hitung indeks gubahan bagi kos pembuatan pencuci mulut itu pada tahun 2017 *berasaskan tahun* 2015.

[2 *marks*/2 *markah*]

(d) The composite index for the cost of making the dessert increased by 30% from the year 2017 to the year 2019. Calculate the price of a bowl of the dessert in the year 2019 if its corresponding price in the year 2015 is RM15.
Indeks gubahan bagi kos pembuatan pencuci mulut itu meningkat sebanyak 30% *daripada tahun* 2017 *ke tahun* 2019. *Hitung harga bagi semangkuk pencuci mulut itu pada tahun* 2019 *jika harga yang sepadan pada tahun* 2015 *ialah* RM15.

[3 *marks*/3 *markah*]

END OF QUESTION PAPER
KERTAS PEPERIKSAAN TAMAT

NO. KAD PENGENALAN	______ - ______ - ______
ANGKA GILIRAN	________

KERTAS MODEL 3

MODEL SIJIL PELAJARAN MALAYSIA

ADDITIONAL MATHEMATICS 3472/1

Kertas 1

2 jam **Dua jam**

1. Kertas peperiksaan ini adalah dalam dwibahasa.
2. Soalan dalam bahasa Inggeris mendahului soalan yang sepadan dalam bahasa Melayu.

INFORMATION FOR CANDIDATES
MAKLUMAT UNTUK CALON

1. This question paper consists of **15** questions.
   Kertas peperiksaan ini mengandungi **15** *soalan.*
2. Answer **all** the questions in **Section A** and any **two** questions from **Section B**.
   Jawab **semua** *soalan dalam* ***Bahagian*** **A** *dan mana-mana* **dua** *soalan daripada* ***Bahagian*** **B**.
3. Write your answers in the spaces provided in the question paper.
   Tulis jawapan anda dalam ruang yang disediakan dalam kertas peperiksaan.
4. Show your working. It may help you to get marks.
   Tunjukkan langkah-langkah penting dalam kerja mengira anda. Ini boleh membantu anda mendapatkan markah.
5. The diagrams provided in the questions are not drawn to scale unless stated.
   Rajah yang mengiringi soalan tidak dilukis mengikut skala kecuali dinyatakan.
6. You may use a scientific calculator.
   Anda dibenarkan menggunakan kalkulator saintifik.

Untuk Kegunaan Pemeriksa

Kod Pemeriksa:

Bahagian	Soalan	Markah Penuh	Markah Diperoleh
A	1	5	
	2	5	
	3	6	
	4	6	
	5	5	
	6	5	
	7	6	
	8	5	
	9	5	
	10	5	
	11	5	
	12	6	
B	13	8	
	14	8	
	15	8	
Jumlah		80	

Section A
Bahagian A

[64 *marks*/64 *markah*]

Answer **all** the questions.
Jawab **semua** *soalan.*

1 Diagram 1 shows a function f that maps x to y and a function g that maps y to z. It is given that $f : x \rightarrow ax^2 + 1$ and $gf : x \rightarrow 6x^2 + b$, where a and b are constants.
Rajah 1 menunjukkan fungsi f yang memetakan x kepada y dan fungsi g yang memetakan y kepada z. Diberi bahawa $f : x \rightarrow ax^2 + 1$ *dan* $gf : x \rightarrow 6x^2 + b$*, dengan keadaan a dan b ialah pemalar.*

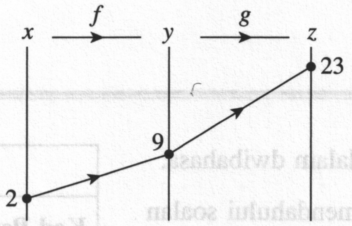

Diagram 1/*Rajah* 1

(a) Find the values of a and b.
Cari nilai a dan nilai b.

[2 *marks*/2 *markah*]

(b) Express the function g in terms of x.
Ungkapkan fungsi g dalam sebutan x.

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

2 (a) Express the non-linear equation $y = kx^4$ in the form of $Y = mX + c$, where k is a constant.
Ungkapkan persamaan tak linear $y = kx^4$ dalam bentuk $Y = mX + c$, dengan k ialah pemalar.

[2 marks/2 *markah*]

(b)

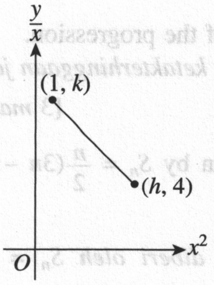

Diagram 2/*Rajah* 2

Diagram 2 shows a straight line graph of $\frac{y}{x}$ against x^2. Given that $y = -x^3 + 10x$, find the values of h and k.

Rajah 2 menunjukkan graf garis lurus $\frac{y}{x}$ melawan x^2. Diberi bahawa $y = -x^3 + 10x$, cari nilai h dan nilai k.

[3 marks/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

3 (a) Solve the equation:
Selesaikan persamaan:
$$2^x(8) = \left(\frac{1}{16}\right)^{2x+3}$$

[3 marks/3 *markah*]

(b) Solve the equation:
Selesaikan persamaan:
$$\log_4 (x + 6) - \log_4 x = 1$$

[3 marks/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

4 (a) A geometric progression is given as $-12, 4, -\frac{4}{3}, \ldots$. Find
Suatu janjang geometri diberi sebagai $-12, 4, -\frac{4}{3}, \ldots$. *Cari*

(i) the common ratio.
nisbah sepunya.

(ii) the sum to infinity of the progression.
hasil tambah hingga ketakterhinggaan janjang itu.

[3 *marks*/3 *markah*]

(b) The sum of the first n terms of an arithmetic progression is given by $S_n = \frac{n}{2}(3n - 11)$. Find the tenth term of the progression.
Hasil tambah n sebutan pertama bagi suatu janjang aritmetik diberi oleh $S_n = \frac{n}{2}(3n - 11)$. *Cari sebutan kesepuluh bagi janjang itu.*

[3 *marks*/3 *markah*]

Answer/*Jawapan*:
(a)

(b)

---

5 (a) Given C is a point on a line segment joining the points $A(-12, 1)$ and $B(3, 7)$ such that $AC = \frac{1}{3}AB$. Find the coordinates of point C.
Diberi C ialah satu titik pada tembereng garis yang menyambungkan titik $A(-12, 1)$ *dan titik* $B(3, 7)$ *dengan keadaan* $AC = \frac{1}{3}AB$. *Cari koordinat titik C.*

[3 *marks*/3 *markah*]

(b) The vertices of a triangle are (1, 3), (5, 2) and $(-3, k)$. If the area of the triangle is 12 unit^2, find the possible values of k.
Bucu-bucu sebuah segi tiga ialah (1, 3), (5, 2) dan $(-3, k)$. *Jika luas segi tiga itu ialah 12 unit*^{2}, *cari nilai-nilai k yang mungkin.*

[2 *marks*/2 *markah*]

Answer /*Jawapan*:
(a)

(b)

6 (a) Diagram 6 shows a vector $\overrightarrow{OP}$. Express each of the following in the form $\underset{\sim}{x}i + \underset{\sim}{y}j$.

Rajah 6 menunjukkan vektor $\overrightarrow{OP}$. *Ungkapkan setiap yang berikut dalam bentuk* $x\underset{\sim}{i} + y\underset{\sim}{j}$.

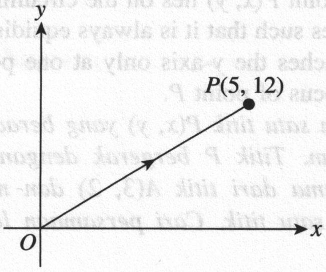

Diagram 6/*Rajah* 6

(i) $\overrightarrow{OP}$

(ii) Unit vector in the direction of $\overrightarrow{OP}$

Vektor unit dalam arah $\overrightarrow{OP}$

[2 marks/*2 markah*]

(b) Three points, A, B and C, are collinear. Given $\overrightarrow{AB} = \underset{\sim}{m}$, $\overrightarrow{BC} = (p - 3)\underset{\sim}{m}$ and $AB = \frac{2}{3}AC$, where p is a constant. Find the value of p.

Tiga titik, A, B dan C, adalah segaris. Diberi bahawa $\overrightarrow{AB} = \underset{\sim}{m}$, $\overrightarrow{BC} = (p - 3)\underset{\sim}{m}$ *dan* $AB = \frac{2}{3}AC$, *dengan keadaan p ialah pemalar. Cari nilai p.*

[3 marks/*3 markah*]

Answer/*Jawapan*:

(a) (b)

---

7 (a) Given $\cos A = -\frac{12}{13}$ and $\sin B = \frac{3}{5}$, where A is an obtuse angle and B is an acute angle. Find

Diberi bahawa kos $A = -\frac{12}{13}$ *dan* sin $B = \frac{3}{5}$, *dengan keadaan A ialah sudut cakah dan B ialah sudut tirus. Cari*

(i) $\tan A$.

(ii) $\sin (A - B)$.

[3 marks/*3 markah*]

(b) Solve the equation $4 \cos 2x + \sin x = -3$ for $0° \leqslant x \leqslant 360°$.

Selesaikan persamaan 4 kos $2x + \sin x = -3$ *untuk* $0° \leqslant x \leqslant 360°$.

[3 marks/*3 markah*]

Answer/*Jawapan*:

(a) (b)

8 (a)

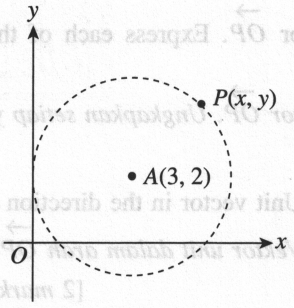

Diagram 8/*Rajah* 8

Diagram 8 shows a point $P(x, y)$ lies on the circumference of a circle. Point P moves such that it is always equidistant from point $A(3, 2)$ and touches the y-axis only at one point. Find the equation of the locus of point P.
Rajah 8 menunjukkan satu titik $P(x, y)$ yang berada di atas lilitan sebuah bulatan. Titik P bergerak dengan keadaan jaraknya sentiasa sama dari titik $A(3, 2)$ dan menyentuh paksi-y hanya pada satu titik. Cari persamaan lokus bagi titik P.

[2 *marks*/2 *markah*]

(b) Sanusi is an engineer and his yearly income is RM90 000 with 20% yearly increment. Jeff is an architect and his yearly income is RM200 000 without any increment. Calculate the difference of the total incomes, in RM, between Sanusi and Jeff for 10 years.
Sanusi ialah seorang jurutera dan pendapatan tahunannya ialah RM90 000 *dengan kenaikan gaji tahunan sebanyak* 20%. *Jeff ialah seorang arkitek dan pendapatan tahunannya ialah* RM200 000 *tanpa sebarang kenaikan gaji. Hitung beza jumlah pendapatan, dalam* RM, *antara Sanusi dan Jeff untuk* 10 *tahun.*

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

9 (a) Given a function $m : x \rightarrow \frac{4-x}{3}$ and a composite function $mn : x \rightarrow 1 + \frac{x}{3}$. Find

Diberi fungsi $m : x \rightarrow \frac{4-x}{3}$ *dan fungsi gubahan* $mn : x \rightarrow 1 + \frac{x}{3}$. *Cari*

(i) $n(x)$.

(ii) the value of x when $m(x) = n(x)$.
nilai x apabila $m(x) = n(x)$.

[3 *marks*/3 *markah*]

(b) Given the quadratic equation $(2k + 1)x^2 - 3kx + 2k - 4 = 0$ does not have real roots. Find the range of values of k.
Diberi bahawa persamaan kuadratik $(2k + 1)x^2 - 3kx + 2k - 4 = 0$ *tidak mempunyai punca nyata. Cari julat nilai k.*

[2 *marks*/2 *markah*]

Answer/*Jawapan*:

(a)

(b)

---

10 (a) Given that $y = 2x(x - 6)$, find the value of $\frac{dy}{dx}$ when $x = 1$. Hence, find the value of x when the value of y is minimum.

Diberi $y = 2x(x - 6)$, *cari nilai* $\frac{dy}{dx}$ *apabila* $x = 1$. *Seterusnya, cari nilai x apabila nilai y adalah minimum.*

[3 *marks*/3 *markah*]

(b) Given that $\int \frac{8}{(3-2x)^3}\,dx = k(3 - 2x)^n + c$, find the values of k and n.

Diberi $\int \frac{8}{(3-2x)^3}\,dx = k(3 - 2x)^n + c$, *cari nilai k dan nilai n.*

[2 *marks*/2 *markah*]

Answer/*Jawapan*:

(a)

(b)

11 (a) A drama team consists of 4 boys and 5 girls are to be chosen from 6 boys and 7 girls. Find the number of ways
Satu pasukan drama yang terdiri daripada 4 orang murid lelaki dan 5 orang murid perempuan akan dipilih daripada 6 orang murid lelaki dan 7 orang murid perempuan. Cari bilangan cara

(i) the drama team can be formed.
pasukan drama itu dapat dibentuk.

(ii) the drama team can be arranged in a row for taking photographs if the 5 girls are seated next to each other.
pasukan drama itu boleh disusun dalam satu baris untuk mengambil gambar foto jika 5 orang murid perempuan itu duduk bersebelahan antara satu sama lain.

[3 *marks*/3 *markah*]

(b) Diagram 11 shows five parking spaces for motorcycles and bicycles.
Rajah 11 menunjukkan lima parkir untuk motosikal dan basikal.

Motorcycle *Motosikal*	Motorcycle *Motosikal*	Bicycle *Basikal*	Motorcycle *Motosikal*	Motorcycle *Motosikal*

Diagram 11/*Rajah* 11

Find the number of ways of arranging 6 motorcycles and 3 bicycles at the parking spaces.
Cari bilangan cara untuk menyusun 6 buah motosikal dan 3 buah basikal di parkir itu.

[2 *marks*/2 *markah*]

Answer/*Jawapan*:
(a)

(b)

12 (a) In a study, it is found that 35% of baby turtles survive until adulthood. If 10 baby turtles are selected at random, find the probability that
Dalam suatu kajian, didapati bahawa 35% daripada anak penyu berjaya menjadi dewasa. Jika 10 ekor anak penyu dipilih secara rawak, cari kebarangkalian bahawa

(i) only 6 baby turtles survive until adulthood.
hanya 6 ekor anak penyu berjaya menjadi dewasa.

(ii) at most 7 baby turtles survive until adulthood.
selebih-lebihnya 7 ekor anak penyu berjaya menjadi dewasa.

[4 marks/*4 markah*]

(b) Table 12 shows the probability distribution of a random variable X.
Jadual 12 menunjukkan taburan kebarangkalian bagi satu pemboleh ubah rawak X.

$X = r$	0	1	2	3
$P(X = r)$	0.2	m	0.1	0.3

Table 12/*Jadual 12*

Find
Cari

(i) the value of m.
nilai m.

(ii) $P(X \geqslant 1)$.

[2 marks/*2 markah*]

Answer/*Jawapan*:

(a)

(b)

Section B
Bahagian B

[16 *marks*/16 *markah*]

Answer any **two** questions from this section.
Jawab mana-mana **dua** *soalan daripada bahagian ini.*

13 (a) A round-shaped cake is cut into several sectors of the same size. The top part of a piece of cake cut has a surface area of 48 cm^2 and an arc length of 8 cm. Calculate the diameter, in cm, of the cake.
Sebiji kek berbentuk bulatan dipotong kepada beberapa sektor yang sama saiz. Bahagian atas sekeping kek yang dipotong itu mempunyai luas permukaan 48 cm^2 *dan panjang lengkok* 8 cm. *Hitung diameter, dalam* cm, *kek itu.*

[3 *marks*/3 *markah*]

(b) In a 10 000 m race, an athlete completes the first lap in 61 seconds. For the following lap, the athlete spends 1.2 seconds longer than the previous lap. Calculate the time, in seconds, taken by the athlete
Dalam suatu perlumbaan 10 000 m, *seorang atlet menghabiskan pusingan pertama dalam* 61 *saat. Untuk pusingan berikutnya, atlet itu mengambil* 1.2 *saat lebih lama daripada pusingan sebelumnya. Hitung masa, dalam saat, yang diambil oleh atlet itu*

(i) for the sixth lap.
untuk pusingan keenam.

(ii) to complete the race.
untuk menamatkan perlumbaan itu.

(iii) for the last eight laps.
untuk lapan pusingan terakhir.

[5 *marks*/5 *markah*]

Answer/*Jawapan*:
(a)

(b)

14 (a) Encik Nazri has a rectangular plot of land. He builds a fish pond and a playground as shown in Diagram 14(a).
Encik Nazri mempunyai sebidang tanah berbentuk segi empat tepat. Dia membina sebuah kolam ikan dan sebuah taman permainan seperti yang ditunjukkan dalam Rajah 14(a).

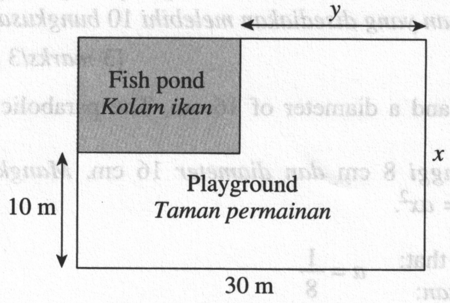

Diagram 14(a)/*Rajah* 14(a)

The region built for the playground has an area of 460 m^2 and the perimeter for the fish pond is 48 m. Find the lengths of x and y, in m.
Kawasan yang dibina untuk taman permainan itu adalah seluas 460 m^2 *dan perimeter bagi kolam ikan itu ialah* 48 m. *Cari panjang x dan y, dalam* m.

[4 *marks*/4 *markah*]

(b) Three plates with a radius of 6 cm each are arranged as shown in Diagram 14(b).
Tiga pinggan yang setiapnya berjejari 6 cm *disusun seperti yang ditunjukkan dalam Rajah* 14(b).

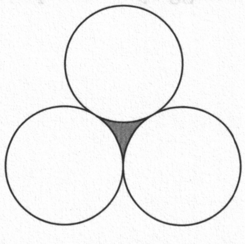

Diagram 14(b)/*Rajah* 14(b)

Using $\pi = 3.142$, calculate
Dengan menggunakan $\pi = 3.142$, hitung

(i) the perimeter, in cm, of the shaded region.
perimeter, dalam cm, *kawasan berlorek.*

(ii) the area, in cm^2, of the shaded region.
luas, dalam cm^2, *kawasan berlorek.*

[4 *marks*/4 *markah*]

Answer/*Jawapan*:
(a)

(b)

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15 (a) The number of packs of food prepared by a food stall per hour is given by the function $g(x) = x^2 - 18x + k$, where k is a constant and x is the number of workers in the stall. Find the range of values of k such that the number of packs of food prepared exceeds 10 packs per hour.
Bilangan bungkusan makanan yang disediakan di sebuah gerai makanan dalam sejam diberi oleh fungsi $g(x) = x^2 - 18x + k$, dengan keadaan k ialah pemalar dan x ialah bilangan pekerja di gerai itu. Cari julat nilai k supaya bilangan bungkusan makanan yang disediakan melebihi 10 bungkusan sejam.

[3 marks/*3 markah*]

(b) Diagram 15 shows a bowl with a height of 8 cm and a diameter of 16 cm. The parabolic bowl is represented by the equation $y = ax^2$.
Rajah 15 menunjukkan sebiji mangkuk dengan tinggi 8 cm dan diameter 16 cm. Mangkuk yang berbentuk parabola itu diwakili oleh persamaan $y = ax^2$.

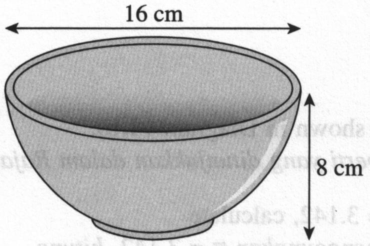

Diagram 15/*Rajah* 15

(i) Prove that: / *Buktikan*: $a = \frac{1}{8}$

(ii) Porridge is poured into the bowl. Calculate the volume of the porridge when the height reaches 6 cm.
Bubur dituang ke dalam mangkuk itu. Hitung isi padu bubur apabila tingginya mencapai 6 cm.

[5 marks/*5 markah*]

Answer/*Jawapan*:

(a)

(b)

END OF QUESTION PAPER

KERTAS PEPERIKSAAN TAMAT

KERTAS MODEL 3

MODEL SIJIL PELAJARAN MALAYSIA

ADDITIONAL MATHEMATICS 3472/2

Kertas 2

2 jam 30 minit **Dua jam tiga puluh minit**

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1. Kertas peperiksaan ini adalah dalam dwibahasa.
2. Soalan dalam bahasa Inggeris mendahului soalan yang sepadan dalam bahasa Melayu.

INFORMATION FOR CANDIDATES
MAKLUMAT UNTUK CALON

1. This question paper consists of three sections: **Section A**, **Section B** and **Section C**.
   Kertas peperiksaan ini mengandungi tiga bahagian: ***Bahagian* A**, ***Bahagian* B** *dan* ***Bahagian* C**.
2. Answer **all** the questions in **Section A**, any **three** questions from **Section B** and any **two** questions from **Section C**.
   Jawab **semua** *soalan dalam* ***Bahagian* A**, *mana-mana* **tiga** *soalan daripada* ***Bahagian* B** *dan mana-mana* **dua** *soalan daripada* ***Bahagian* C**.
3. Show your working. It may help you to get marks.
   Tunjukkan langkah-langkah penting dalam kerja mengira anda. Ini boleh membantu anda mendapatkan markah.
4. The diagrams provided in the questions are not drawn to scale unless stated.
   Rajah yang mengiringi soalan tidak dilukis mengikut skala kecuali dinyatakan.
5. You may use a scientific calculator.
   Anda dibenarkan menggunakan kalkulator saintifik.

Section A
Bahagian A

[50 *marks*/50 *markah*]

Answer **all** the questions in this section.
Jawab **semua** *soalan dalam bahagian ini.*

1 Diagram 1 shows part of a wedding cake which consists of several layers. Each layer of cake is in cylindrical shape and with a height of 8 cm. The top most layer of cake has a circumference of 20π cm and the radius of each subsequent layer of cake is increased by 4 cm from the one on top of it. The volume of the bottom most layer of cake is $14\ 112\pi\ cm^3$.
Rajah 1 *menunjukkan sebahagian daripada sebuah kek perkahwinan yang terdiri daripada beberapa lapisan. Setiap lapisan kek berbentuk silinder dengan tinggi* 8 cm. *Lapisan kek yang paling atas mempunyai lilitan* 20π cm *dan jejari setiap lapisan kek berikutnya bertambah sebanyak* 4 cm *daripada lapisan kek yang berada di atasnya. Isi padu lapisan kek yang bawah sekali ialah* $14\ 112\pi\ cm^3$.

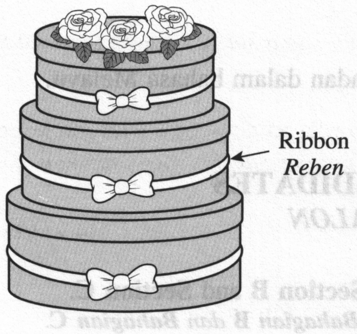


Diagram 1/*Rajah* 1

(a) Find the height, in cm, of the whole wedding cake.
Cari tinggi, dalam cm, *seluruh kek perkahwinan itu.*

[5 *marks*/5 *markah*]

(b) Ribbon is used to decorate the wedding cake. Find the total length, in cm, of the ribbon needed.
Reben digunakan untuk menghiasi kek perkahwinan itu. Cari jumlah panjang, dalam cm, *reben yang diperlukan.*

[3 *marks*/3 *markah*]

2 Diagram 2 shows the curve $y = x^2 + 3$ intersects the straight line $2y + 3x = 20$ at point A.
Rajah 2 *menunjukkan lengkung* $y = x^2 + 3$ *menyilang garis lurus* $2y + 3x = 20$ *pada titik* A.

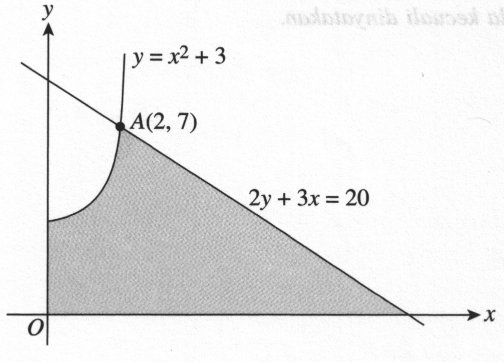


Diagram 2/*Rajah* 2

Calculate
Hitung

(a) the area of the shaded region.
luas rantau berlorek.

[4 *marks*/4 *markah*]

(b) the volume generated, in terms of π, when the region bounded by the curve, the y-axis and $y = 7$ is rotated through 360° about the y-axis.
isi padu janaan, dalam sebutan π, *apabila rantau yang dibatasi oleh lengkung itu, paksi-y dan* $y = 7$ *diputarkan melalui* 360° *pada paksi-y.*

[4 *marks*/4 *markah*]

3 Diagram 3 shows a piece of rectangular cardboard and an open box that is made from the cardboard.
Rajah 3 menunjukkan sekeping kadbod berbentuk segi empat tepat dan sebuah kotak terbuka yang dibuat daripada kadbod itu.

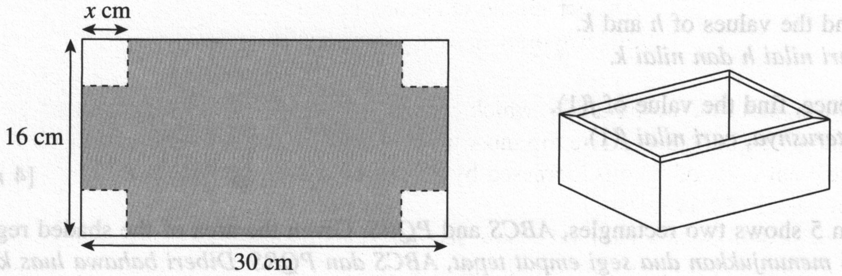


Diagram 3/*Rajah 3*

The box is made by cutting out four squares of equal size from the corners of the cardboard and then folding up the sides. Find
Kotak itu dibuat dengan memotong empat segi empat sama yang sama saiz daripada bucu kadbod itu dan kemudiannya bahagian tepi dilipatkan. Cari

(a) the length, in cm, of sides of the squares to be cut out in order to get a box with the largest volume.
panjang, dalam cm, *tepi segi empat sama yang akan dipotong supaya mendapatkan kotak dengan isi padu terbesar.*

[4 *marks*/4 *markah*]

(b) the minimum number of the boxes needed to fill with 5 645 cm^3 of pudding.
bilangan minimum kotak yang diperlukan untuk mengisi 5 645 cm^3 *puding.*

[3 *marks*/3 *markah*]

4 Solve the following simultaneous equations:
Selesaikan persamaan serentak yang berikut:

$$4x + 3y - 8 = 0 \quad , \quad x^2 - xy - 8 = 0$$

Give the answers correct to three decimal places.
Beri jawapan betul kepada tiga tempat perpuluhan.

[5 *marks*/5 *markah*]

5 (a) A function f is defined by $f(x) = hx + k$, where h and k are constants. It is given that $f(-1) = -11$ and $f(2) = 7$.
Suatu fungsi f ditakrifkan sebagai $f(x) = hx + k$, dengan keadaan h dan k ialah pemalar. Diberi bahawa $f(-1) = -11$ dan $f(2) = 7$.

(i) Find the values of h and k.
Cari nilai h dan nilai k.

(ii) Hence, find the value of $f(1)$.
Seterusnya, cari nilai $f(1)$.

[4 *marks*/4 *markah*]

(b) Diagram 5 shows two rectangles, *ABCS* and *PQRS*. Given the area of the shaded region is 69 cm^2.
Rajah 5 menunjukkan dua segi empat tepat, ABCS dan PQRS. Diberi bahawa luas kawasan berlorek ialah 69 cm^2.

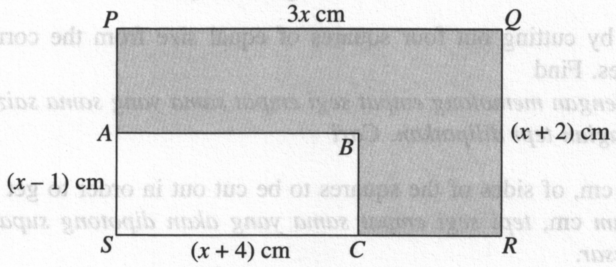


Diagram 5/*Rajah* 5

Form a quadratic equation in the form $ax^2 + bx + c = 0$.
Bentukkan satu persamaan kuadratik dalam bentuk $ax^2 + bx + c = 0$.

[3 *marks*/3 *markah*]

6 Solution by scale drawing is not accepted.
Penyelesaian secara lukisan berskala tidak diterima.

Diagram 6 shows a triangle *POQ*. Point *T* lies on the line *PQ* such that *PT* : *TQ* = 3 : 2.
Rajah 6 menunjukkan segi tiga POQ. Titik T berada pada garis PQ dengan keadaan PT : TQ = 3 : 2.

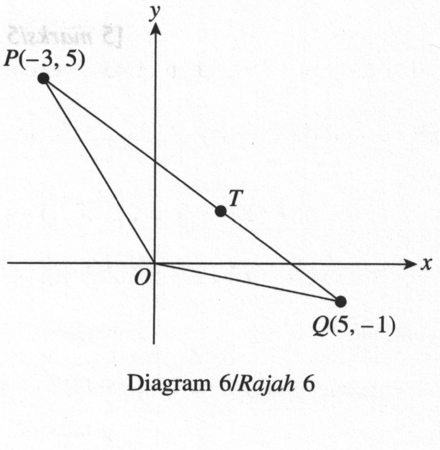


Diagram 6/*Rajah* 6

(a) Calculate the area, in unit^2, of triangle *POQ*.
Hitung luas, dalam unit^2, segi tiga POQ.

[2 *marks*/2 *markah*]

(b) Find the coordinates of point *T*.
Cari koordinat bagi titik T.

[2 *marks*/2 *markah*]

(c) A point *A* moves such that its distance from *P* is always twice its distance from *Q*. Find the equation of the locus of point *A*.
Titik A bergerak dengan keadaan jaraknya dari P sentiasa dua kali jaraknya dari Q. Cari persamaan lokus bagi titik A.

[3 *marks*/3 *markah*]

7 Diagram 7 shows a circle with centre O and a sector of a circle with centre A. The lengths of arc MN and arc JK are 15 cm and 12 cm respectively. Given $OK = 8$ cm, $JK = 10$ cm and $\theta = 1.36$ rad.
Rajah 7 menunjukkan sebuah bulatan berpusat O dan sebuah sektor bulatan berpusat A. Panjang lengkok MN dan lengkok JK masing-masing ialah 15 cm dan 12 cm. Diberi OK = 8 cm, JK = 10 cm dan $\theta = 1.36$ rad.

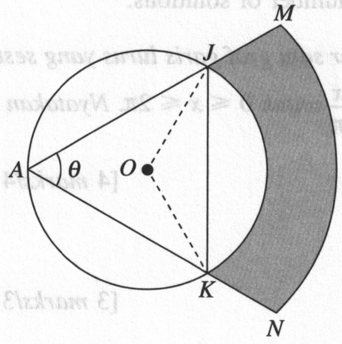


Diagram 7/*Rajah 7*

[Use/*Guna* $\pi = 3.142$]

(a) Find the perimeter, in cm, of the shaded region.
Cari perimeter, dalam cm, *kawasan berlorek.*
[3 *marks*/3 *markah*]

(b) Calculate the area, in cm^2, of the shaded region.
Hitung luas, dalam cm^2, *kawasan berlorek.*
[5 *marks*/5 *markah*]

Section B
Bahagian B
[30 *marks*/30 *markah*]

Answer any **three** questions from this section.
Jawab mana-mana **tiga** *soalan daripada bahagian ini.*

8 (a) It is found that 10% of the cats in a cage have yellow fur. If 10 cats from the cage are chosen at random, calculate the probability that
Didapati bahawa 10% daripada kucing di dalam sebuah sangkar berbulu kuning. Jika 10 *ekor kucing dari sangkar itu dipilih secara rawak, hitung kebarangkalian bahawa*

(i) exactly 2 cats have yellow fur.
tepat 2 *ekor kucing berbulu kuning.*

(ii) less than 4 cats have yellow fur.
kurang daripada 4 *ekor kucing berbulu kuning.*

[5 *marks*/5 *markah*]

(b) The masses of the students in a school follow a normal distribution with a mean of 43 kg and a standard deviation of 10 kg. Calculate
Jisim murid-murid di sebuah sekolah mengikut taburan normal dengan min 43 kg *dan sisihan piawai* 10 kg. *Hitung*

(i) the probability that a student chosen randomly from the school has a mass of not more than 55.9 kg.
kebarangkalian bahawa seorang murid yang dipilih secara rawak dari sekolah itu mempunyai jisim tidak melebihi 55.9 kg.

(ii) the value of m, if 60% of the students from the school have a mass of more than m kg.
nilai m, jika 60% daripada murid-murid di sekolah itu mempunyai jisim melebihi m kg.

[5 *marks*/5 *markah*]

9 (a) (i) Sketch the graph of $y = 2 \cos 2x - 1$ for $0 \leqslant x \leqslant 2\pi$.
Lakarkan graf bagi $y = 2 \text{ kos } 2x - 1$ *untuk* $0 \leqslant x \leqslant 2\pi$.

[3 marks/3 *markah*]

(ii) Hence, using the same axes, sketch a suitable straight line graph to find the solutions to the equation $2 \cos 2x + 2 = \dfrac{3x}{2\pi}$ for $0 \leqslant x \leqslant 2\pi$. State the number of solutions.

Seterusnya, dengan menggunakan paksi yang sama, lakar satu graf garis lurus yang sesuai untuk mencari penyelesaian bagi persamaan $2 \text{ kos } 2x + 2 = \dfrac{3x}{2\pi}$ *untuk* $0 \leqslant x \leqslant 2\pi$. *Nyatakan bilangan penyelesaian itu.*

[4 marks/4 *markah*]

(b) Prove that $2 \cos (x + 45°) \cos (x - 45°) = \cos 2x$.
Buktikan $2 \text{ kos } (x + 45°) \text{ kos } (x - 45°) = \text{kos } 2x$.

[3 marks/3 *markah*]

10 Use graph paper to answer this question.
Gunakan kertas graf untuk menjawab soalan ini.

Table 10 shows the values of two variables, x and y, obtained from an experiment. The variables x and y are related by the equation $y = hx^{k+1}$, where h and k are constants.
Jadual 10 menunjukkan nilai-nilai bagi dua pemboleh ubah, x dan y, yang diperoleh daripada satu eksperimen. Pemboleh ubah x dan y dihubungkan oleh persamaan $y = hx^{k+1}$, *dengan keadaan h dan k ialah pemalar.*

x	2	3	4	5	6	7
y	1.59	3.61	6.39	10.24	14.32	19.71

Table 10/*Jadual* 10

(a) Plot $\log_{10} y$ against $\log_{10} x$, using a scale of 2 cm to 0.2 unit on both axes. Hence, draw the line of best fit.
Plot $\log_{10} y$ *melawan* $\log_{10} x$, *dengan menggunakan skala* 2 cm *kepada* 0.2 unit *pada kedua-dua paksi. Seterusnya, lukis garis lurus penyuaian terbaik.*

[4 marks/4 *markah*]

(b) Using the graph in (a), find
Dengan menggunakan graf di (a), cari

(i) the values of h and k.
nilai h dan nilai k.

(ii) the value of y when $x = 4.5$.
nilai y apabila $x = 4.5$.

[6 marks/6 *markah*]

11 Diagram 11 shows two triangles, *OPQ* and *OPS*. It is given that $\overrightarrow{OP} = 8\underset{\sim}{x}$, $\overrightarrow{OQ} = 10\underset{\sim}{y}$ and $\overrightarrow{PS} = 4\underset{\sim}{y}$.

Rajah 11 menunjukkan dua segi tiga, OPQ dan OPS. Diberi bahawa $\overrightarrow{OP} = 8\underset{\sim}{x}$, $\overrightarrow{OQ} = 10\underset{\sim}{y}$ *dan* $\overrightarrow{PS} = 4\underset{\sim}{y}$.

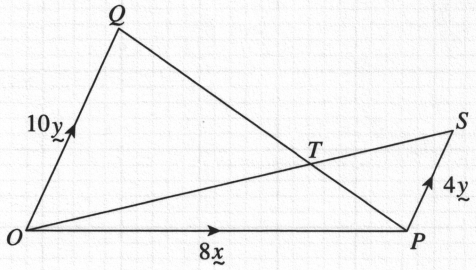


Diagram 11/*Rajah* 11

(a) Express each of the following vectors in terms of $\underset{\sim}{x}$ and $\underset{\sim}{y}$:
Ungkapkan setiap vektor yang berikut dalam sebutan $\underset{\sim}{x}$ *dan* $\underset{\sim}{y}$:

(i) $\overrightarrow{OS}$ (ii) $\overrightarrow{PQ}$

[3 *marks*/3 *markah*]

(b) Given that $\overrightarrow{OT} = h\overrightarrow{OS}$ and $\overrightarrow{PT} = k\overrightarrow{PQ}$, where *h* and *k* are constants. Express $\overrightarrow{OT}$ in terms of
Diberi $\overrightarrow{OT} = h\overrightarrow{OS}$ *dan* $\overrightarrow{PT} = k\overrightarrow{PQ}$, *dengan h dan k ialah pemalar. Ungkapkan* $\overrightarrow{OT}$ *dalam sebutan*

(i) h, $\underset{\sim}{x}$ and $\underset{\sim}{y}$.
h, $\underset{\sim}{x}$ *dan* $\underset{\sim}{y}$.

(ii) k, $\underset{\sim}{x}$ and $\underset{\sim}{y}$.
k, $\underset{\sim}{x}$ *dan* $\underset{\sim}{y}$.

[4 *marks*/4 *markah*]

(c) Find the values of *h* and *k*. Hence, determine *OT* : *TS*.
Cari nilai h dan nilai k. Seterusnya, tentukan OT : TS.

[3 *marks*/3 *markah*]

Section C
Bahagian C

[20 *marks*/20 *markah*]

Answer any **two** questions from this section.
Jawab mana-mana **dua** *soalan daripada bahagian ini.*

12 (a) Diagram 12(a) shows two triangles, *ABC* and *CED*. *AEC* is a straight line and $\angle BCA = 60°$.
Rajah 12(a) *menunjukkan dua segi tiga, ABC dan CED. AEC ialah garis lurus dan* $\angle BCA = 60°$.

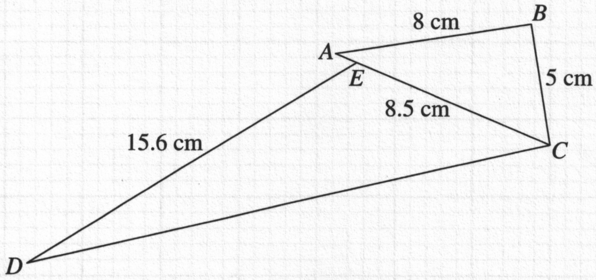


Diagram 12(a)/*Rajah* 12(a)

(i) Calculate the length of *AE*, in cm.
Hitung panjang AE, dalam cm.

[3 *marks*/3 *markah*]

(ii) Find $\angle CED$, in degrees, if the area of triangle *CED* is 54 cm^2.
Cari $\angle CED$, *dalam darjah, jika luas segi tiga CED ialah* 54 cm^2.

[2 *marks*/2 *markah*]

(b) Diagram 12(b) shows a right prism with an isosceles triangular base where $DE = DF = 10$ cm.
Rajah 12(b) *menunjukkan sebuah prisma tegak bertapak segi tiga sama kaki dengan* $DE = DF = 10$ cm.

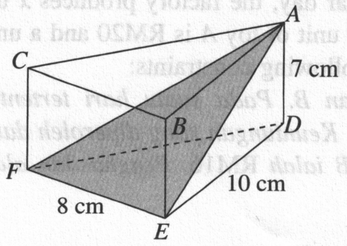


Diagram 12(b)/*Rajah* 12(b)

(i) Calculate the angle between the line AE and the base DEF.
Hitung sudut antara garis AE dengan tapak DEF.
[2 *marks*/2 *markah*]

(ii) Find $\angle FAE$, in degrees.
Cari $\angle FAE$, *dalam darjah.*
[3 *marks*/3 *markah*]

13 Table 13 shows the price indices in the year 2021 based on the year 2020 and the weightages of four types of materials used in making pizza.
Jadual 13 *menunjukkan indeks harga pada tahun* 2021 *berasaskan tahun* 2020 *serta pemberatnya bagi empat jenis bahan yang digunakan dalam pembuatan piza.*

Material *Bahan*	**Price index in the year 2021** ***Indeks harga pada tahun 2021*** **(2020 = 100)**	**Weightage** *Pemberat*
A	125	4
B	120	*p*
C	80	5
D	150	*p* + 3

Table 13/*Jadual* 13

(a) The price of material A is RM50 in the year 2021. Find the corresponding price in the year 2020.
Harga bahan A ialah RM50 *pada tahun* 2021. *Cari harganya yang sepadan pada tahun* 2020.
[2 *marks*/2 *markah*]

(b) The composite index for the prices of the materials in the year 2021 based on the year 2020 is 120. Find the value of p.
Indeks gubahan bagi harga bahan-bahan itu pada tahun 2021 *berasaskan tahun* 2020 *ialah* 120. *Cari nilai p.*
[3 *marks*/3 *markah*]

(c) Find the price of a piece of pizza in the year 2021 if its price in the year 2020 is RM15.
Cari harga sekeping piza pada tahun 2021 *jika harganya pada tahun* 2020 *ialah* RM15.
[2 *marks*/2 *markah*]

(d) Given the price of material C is estimated to increase by 15% from the year 2021 to the year 2023, while the other materials remain unchanged. Calculate the composite index for the cost of making the pizza in the year 2023 based on the year 2020.
Diberi harga bahan C dianggarkan meningkat sebanyak 15% *daripada tahun* 2021 *ke tahun* 2023, *sementara bahan yang lain tidak berubah. Hitung indeks gubahan bagi kos pembuatan piza itu pada tahun* 2023 *berasaskan tahun* 2020.
[3 *marks*/3 *markah*]

14 Use graph paper to answer this question.
Gunakan kertas graf untuk menjawab soalan ini.

A factory produces two types of toys, A and B. In a particular day, the factory produces x units of toy A and y units of toy B. The profits obtained from the sales of a unit of toy A is RM20 and a unit of toy B is RM16. The production of the toys per day is based on the following constraints:
Sebuah kilang menghasilkan dua jenis alat mainan, A dan B. Pada suatu hari tertentu, kilang itu menghasilkan x unit alat mainan A dan y unit alat mainan B. Keuntungan yang diperoleh daripada jualan seunit alat mainan A ialah RM20 *dan seunit alat mainan B ialah* RM16. *Penghasilan alat mainan itu dalam sehari adalah berdasarkan kekangan yang berikut:*

I : The total number of toys produced is at most 360 units.
Jumlah alat mainan yang dihasilkan adalah selebih-lebihnya 360 *unit.*

II : The number of toy A produced is not more than 4 times the number of toy B produced.
Bilangan alat mainan A yang dihasilkan tidak melebihi 4 kali bilangan alat mainan B yang dihasilkan.

III : The minimum total profits obtained from both types of toys must be RM5 600.
Jumlah keuntungan minimum diperoleh daripada dua jenis alat mainan itu mesti RM5 600.

(a) Write three inequalities, other than $x \geqslant 0$ and $y \geqslant 0$, which satisfy all the above constraints.
Tulis tiga ketaksamaan, selain $x \geqslant 0$ *dan* $y \geqslant 0$, *yang memenuhi semua kekangan di atas.*
[3 *marks*/3 *markah*]

(b) Using a scale of 2 cm to 40 toys on both axes, construct and shade the region R which satisfies all the above constraints.
Dengan menggunakan skala 2 cm *kepada* 40 *unit alat mainan pada kedua-dua paksi, bina dan lorek rantau R yang memenuhi semua kekangan di atas.*
[3 *marks*/3 *markah*]

(c) Using the graph constructed in (b), find
Dengan menggunakan graf yang dibina di (b), *cari*

(i) the minimum number of toy B produced if the number of toy A produced in a day is 40 units.
bilangan minimum alat mainan B yang dihasilkan jika bilangan alat mainan A yang dihasilkan dalam sehari ialah 40 *unit.*

(ii) the maximum total profits can be obtained per day.
jumlah keuntungan maksimum yang boleh diperoleh dalam sehari.
[4 *marks*/4 *markah*]

15 Henry and Ryan are twins who are playing their toy cars. Diagram 15 shows the positions and directions of motion of the toy cars that are moving in a straight line. Henry's car, H, passes through a fixed point A and Ryan's car, R, passes through a fixed point B simultaneuosly. Given the distance between points A and B is 300 cm.
Henry dan Ryan adalah kembar yang bermain kereta mainan mereka. Rajah 15 *menunjukkan kedudukan dan arah pergerakan bagi kereta mainan yang bergerak dalam satu garis lurus. Kereta Henry, H, melalui titik tetap A dan kereta Ryan, R, melalui titik tetap B secara serentak. Diberi jarak di antara titik A dan titik B ialah* 300 cm.

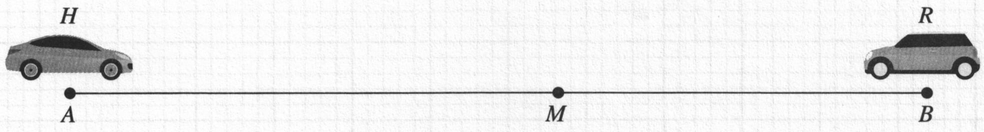


Diagram 15/*Rajah* 15

The velocity of car H, V_H cm s^{-1}, is given by $V_H = 20t - 5t^2 + 25$, where t is the time, in seconds, after it passes point A while car R travels with a constant velocity of -20 cm s^{-1}. Car H stops at a point M.
Halaju kereta H, V_H cm s^{-1}, *diberi oleh* $V_H = 20t - 5t^2 + 25$, *dengan keadaan t ialah masa, dalam saat, setelah melepasi titik A manakala kereta R bergerak dengan halaju malar* -20 cm s^{-1}. *Kereta H berhenti di titik M.*

[Assume the motion to the right is positive.]
[*Anggapkan gerakan ke arah kanan sebagai positif.*]

(a) Find the maximum velocity, in cm s^{-1}, of car H.
Cari halaju maksimum, dalam cm s^{-1}, *kereta H.*

[2 *marks*/2 *markah*]

(b) Calculate the distance, in cm, between the points M and A.
Hitung jarak, dalam cm, *di antara titik M dan titik A.*

[4 *marks*/4 *markah*]

(c) Calculate the distance, in cm, between car H and car R when car H stops at point M.
Hitung jarak, dalam cm, *di antara kereta H dan kereta R ketika kereta H berhenti di titik M.*

[4 *marks*/4 *markah*]

END OF QUESTION PAPER
KERTAS PEPERIKSAAN TAMAT

(6)

NO. KAD PENGENALAN | | | | | | | - | | - | | | | |

ANGKA GILIRAN | | | | | | | | | |

KERTAS MODEL 4

MODEL SIJIL PELAJARAN MALAYSIA

ADDITIONAL MATHEMATICS 3472/1

Kertas 1
2 jam **Dua jam**

1. Kertas peperiksaan ini adalah dalam dwibahasa.
2. Soalan dalam bahasa Inggeris mendahului soalan yang sepadan dalam bahasa Melayu.

INFORMATION FOR CANDIDATES
MAKLUMAT UNTUK CALON

1. This question paper consists of **15** questions.
   Kertas peperiksaan ini mengandungi **15** *soalan.*
2. Answer **all** the questions in **Section A** and any **two** questions from **Section B**.
   Jawab **semua** *soalan dalam* ***Bahagian*** **A** *dan mana-mana* **dua** *soalan daripada* ***Bahagian*** **B**.
3. Write your answers in the spaces provided in the question paper.
   Tulis jawapan anda dalam ruang yang disediakan dalam kertas peperiksaan.
4. Show your working. It may help you to get marks.
   Tunjukkan langkah-langkah penting dalam kerja mengira anda. Ini boleh membantu anda mendapatkan markah.
5. The diagrams provided in the questions are not drawn to scale unless stated.
   Rajah yang mengiringi soalan tidak dilukis mengikut skala kecuali dinyatakan.
6. You may use a scientific calculator.
   Anda dibenarkan menggunakan kalkulator saintifik.

Untuk Kegunaan Pemeriksa

Kod Pemeriksa:

Bahagian	Soalan	Markah Penuh	Markah Diperoleh
A	1	5	
	2	5	
	3	5	
	4	5	
	5	6	
	6	5	
	7	5	
	8	5	
	9	6	
	10	5	
	11	7	
	12	5	
B	13	8	
	14	8	
	15	8	
Jumlah		80	

Section A
Bahagian A

[64 *marks*/64 *markah*]

Answer **all** the questions.
Jawab **semua** *soalan.*

1 (a) A function f is given as $f(x) = 3x + 2$. Find
Suatu fungsi f diberi sebagai $f(x) = 3x + 2$. *Cari*

(i) the image of 2.
imej bagi 2.

(ii) the object of 5.
objek bagi 5.

[2 *marks*/2 *markah*]

(b) Given a function $h : x \rightarrow ax + b$ and the composite function $h^2 : x \rightarrow 9x - 16$, where a and b are constants and $a > 0$. Find the values of a and b.
Diberi fungsi $h : x \rightarrow ax + b$ *dan fungsi gubahan* $h^2 : x \rightarrow 9x - 16$, *dengan keadaan a dan b ialah pemalar dan* $a > 0$. *Cari nilai a dan nilai b.*

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)
i) $f(2) = 3(2) + 2$
$= 8$

ii) $3x + 2 = 5$
$x = \frac{5-2}{3}$
$x = 1$

(b) $h(x) = ax + b$
$hh(x) = a(ax+b) + b$
$= a^2x + ab + b$
$a^2x = ax \quad a = \pm 3$
$a = 3$ #
$ab + b = -16$
$3b + b = -16$
$4b = -16$
$4b = -16$
$b = -4$
$b = -14$ #

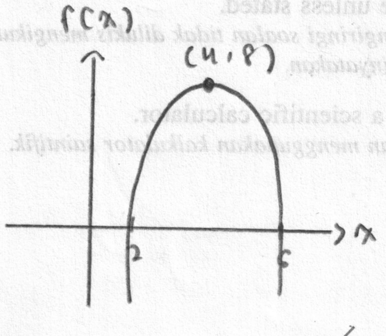
2 Sketch the graph of a quadratic function $f(x) = 8 - 2(x - 4)^2$. Then, state the range of the values of x when $f(x) \geqslant 0$.
Lakarkan graf fungsi kuadratik $f(x) = 8 - 2(x - 4)^2$. *Seterusnya, nyatakan julat nilai x apabila* $f(x) \geqslant 0$.

[5 *marks*/5 *markah*]

Answer/*Jawapan*:

$8 - 2(x-4)^2$
$-2(x-4)^2 = -8$
$2(x-4)^2 = 8$
$(x-4)^2 = 4$
$(x-4) = \pm\sqrt{4}$
$x - 4 = +2$
$= -2$

$x = 6$ — ①
$x = 2$ — ②



$\therefore 2 \leq x \leq 6$ #

3 (a) Given that $\tan \beta = \frac{1}{3}$, where β is an acute angle. Without calculating the value of β, find

Diberi $\tan \beta = \frac{1}{3}$, *dengan keadaan* β *ialah sudut tirus. Tanpa menghitung nilai* β, *cari*

(i) $\tan 2\beta$. (ii) $\tan (90° - \beta)$

[2 *marks*/2 *markah*]

(b) Solve the equation $2 \sec^2 x = 3 - \tan x$ for the domain $0° \leqslant x \leqslant 360°$.
Selesaikan persamaan 2 sek$^2\, x = 3 - \tan x$ *untuk domain* $0° \leqslant x \leqslant 360°$.

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)
i) $\tan 2\beta = \dfrac{2\tan\beta}{1-\tan^2\beta} = \dfrac{2(\frac{1}{3})}{1-(\frac{1}{3})^2} = \frac{3}{4}$

ii) $\tan(90° - \beta) = \cot \beta = 1/\tan\beta = \frac{1}{\frac{1}{3}}$ #, $\tan b = 3$.

(b)
$2(1-\tan^2 x) = 3 - \tan x$
$2 - 2\tan^2 x = 3 - \tan$
$-2\tan^2 x - \tan - 1 = 0$
$(2\tan x - 1)(\tan x + 1) = 0$
$\tan x = \frac{1}{2}$, $\tan x = -1$
$x = 26.57, 135°, 206.57, 315°$

---

4 An arithmetic progression and a geometric progression have the same first term. The common difference and common ratio of both progressions are also the same, that is $\frac{1}{4}$. The ninth term of the arithmetic progression is 10 while its eleventh term is same as the sum of the first n terms of the geometric progression.
Satu janjang aritmetik dan satu janjang geometri mempunyai sebutan pertama yang sama. Beza sepunya dan nisbah sepunya kedua-dua janjang itu juga sama, iaitu $\frac{1}{4}$. *Sebutan kesembilan janjang aritmetik itu ialah* 10 *manakala sebutan kesebelas janjang itu sama dengan jumlah n sebutan pertama janjang geometri itu.*

(a) Find the first term of both the progressions.
Cari sebutan pertama kedua-dua janjang itu.

[2 *marks*/2 *markah*]

(b) Find the value of n.
Cari nilai n.

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)
$T_9 = a + 8d = 10$
$a + 8(\frac{1}{4}) = 10$
$a + 2 = 10$
$a = 8$
$r = d = \frac{1}{4}$

(b)
$T_{11} = S_n$
$a + 10d = \dfrac{a(1-r^n)}{1-r}$
$8 + 10(\frac{1}{4}) = \dfrac{8[1-(\frac{1}{4})^n]}{1-\frac{1}{4}}$
$\frac{21}{2} = \frac{32}{3}[1 - \frac{1}{4}^n]$
$(\frac{1}{4})^n = \frac{1}{64}$, $n = 3$ #

5 The variables x and y are related by an equation $y = \dfrac{1}{px^2 + q}$, where p and q are constants. Diagram 5 shows a straight line graph obtained by plotting $\dfrac{1}{y}$ against x^2.

Pemboleh ubah x dan y dihubungkan oleh persamaan $y = \dfrac{1}{px^2 + q}$, *dengan keadaan p dan q ialah pemalar. Rajah 5 menunjukkan graf garis lurus yang diperoleh dengan memplot* $\dfrac{1}{y}$ *melawan* x^2.

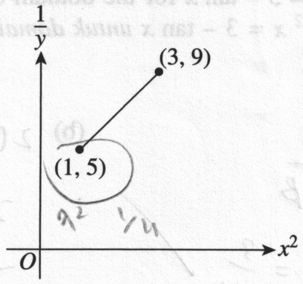


Diagram 5/*Rajah 5*

(a) Find the values of p and q.
Cari nilai p dan nilai q.

[4 marks/*4 markah*]

(b) Hence, determine whether the point (4, 10) lies on the straight line.
Seterusnya, tentukan sama ada titik (4, 10) berada di atas garis lurus itu atau tidak.

[2 marks/*2 markah*]

Answer/*Jawapan*:

(a)

$y = \frac{1}{px^2 + q}$

$\frac{1}{y} = px^2 + q$

$5 = p(1) + q$

$5 = p + q$ — ①

$9 = p(3) + q$

$9 = 3p + q$ — ②

① → $p = 5 - q$

$9 = 3(5 - q) + q$

$9 = 15 - 3q + q$

$9 = 15 - 2q$

$2q = 6$

$q = 3$ #

$p = 5 - 3$

$p = 2$ #

(b)

$y = mx + c$

$9 = 2(3) + c$

$c = 9 - 6$

$c = 3$

$q = 3$ #

6 Solve the following simultaneous equations:
Selesaikan persamaan serentak yang berikut:

$$4x + y + 8 = x^2 + x - y = 2$$

[5 *marks*/5 *markah*]

Answer/*Jawapan*:

$4x + y + 8 = 2 \rightarrow 4x + y = -6$ —①

$x^2 + x - y = 2 \rightarrow x(x+1) - y = 2$

$y = x(x+1) - 2$

$4x + (x(x+1) - 2)$

$4x + x^2 + x - 2 = -6$

$x^2 + 5x + 4 = 0$

$(x+1)(x+4)$ #

$4(-1) + y = -6$

$y = -6 + 4$

$y = -2$ #

$4(-4) + y = -6$

$-16 + y = -6$

$y = 10$ #

---

7 There are six boxes of different flavours of ice creams which are avocado, chocolate, strawberry, mango, lemon and vanilla. A seller wants to arrange the ice creams in a freezer.
Terdapat enam bekas ais krim berperisa berlainan yang terdiri daripada avocado, coklat, strawberi, mangga, lemon dan vanila. Seorang penjual ingin menyusun ais krim itu dalam sebuah penyejuk beku.

(a) Find the number of different arrangements in one row, if he wants to arrange only four flavours of the ice creams.
Cari bilangan susunan berlainan dalam satu baris, jika dia hanya ingin menyusun empat perisa ais krim itu.

[2 *marks*/2 *markah*]

(b) If the strawberry, chocolate, vanilla and lemon flavored ice creams are displayed, find the number of different mixed flavours of ice creams can be chosen by a buyer.
Jika ais krim berperisa strawberi, coklat, vanila dan lemon dipaparkan, cari bilangan campuran perisa ais krim berlainan yang boleh dipilih oleh seorang pembeli.

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

8 Diagram 8 shows a sector ABC of a circle with centre A and a radius of 10 cm. Point D lies on AB such that $AD : AB = 3 : 5$.
Rajah 8 menunjukkan sektor bulatan ABC yang berpusat A dan berjejari 10 cm. *Titik D terletak pada AB dengan keadaan AD* : *AB* = 3 : 5.

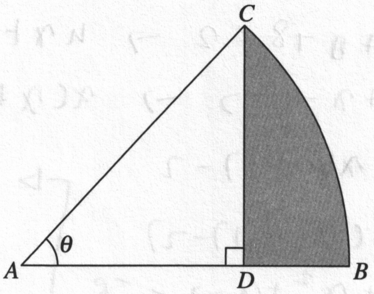


Diagram 5/*Rajah* 5

(a) Find the value of θ, in radian.
Cari nilai θ, dalam radian.

[2 *marks*/2 *markah*]

(b) Hence, calculate the area, in cm^2, of the shaded region.
Seterusnya, hitung luas, dalam cm^2, *kawasan berlorek.*

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)

(b)

9 A straight line $4y + x = k$ is the normal to a curve $y = (2x - 1)^2 - 3$ at a point A. Find
Garis lurus $4y + x = k$ ialah garis normal kepada lengkung $y = (2x - 1)^2 - 3$ pada titik A. Cari

(a) the coordinates of point A and the value of k.
koordinat bagi titik A dan nilai k.

[4 *marks*/*4 markah*]

(b) the equation of the tangent to the curve at point A.
persamaan tangen kepada lengkung itu pada titik A.

[2 *marks*/*2 markah*]

Answer/*Jawapan*:

(a) $y = (2x-1)^2 - 3$

$= 2(2x-1)(2) = 4$

$= 8x - 4 = 4$

$8x = 8$

$x = 1$ #

$y = (2x-1)^2 - 3$

$y = (2(1)-1)^2 - 3$

$= -2$ #

$4(-2)+1 = k = -7$ #

(b) $y - y_1 = m(x - x_1)$

$y - (-2) = 4(x - 1)$

$y + 2 = 4x - 4$

$y = 4x - 6$ #

---

10 (a) It is given that $y = \frac{2x-1}{x^2}$ and $\frac{dy}{dx} = 2g(x)$. Find the value of $\int_1^2 g(x)\,dx$.

Diberi bahawa $y = \frac{2x-1}{x^2}$ dan $\frac{dy}{dx} = 2g(x)$. Cari nilai bagi $\int_1^2 g(x)\,dx$.

[2 *marks*/*2 markah*]

(b) It is given that $\frac{d^2y}{dx^2} = 4x^3 + 1$. When $x = -1$, $y = \frac{1}{2}$ and $\frac{dy}{dx} = 3$. Express y in terms of x.

Diberi bahawa $\frac{d^2y}{dx^2} = 4x^3 + 1$. Apabila $x = -1$, $y = \frac{1}{2}$ dan $\frac{dy}{dx} = 3$. Ungkapkan y dalam sebutan x.

[3 *marks*/*3 markah*]

Answer/*Jawapan*:

(a) $2\left[\frac{2x-1}{x^2}\right]_1^2$

$\frac{1}{2}\left[\left(\frac{2(2)-1}{2^2}\right) - \left(\frac{2(1)-1}{1^2}\right)\right]$

$\frac{1}{2}\left(\frac{3}{4} - 1\right)$

$= -\frac{1}{8}$ #

(b) $\int 4x^3 + 1$

$\frac{dy}{dx} = \frac{4x^4}{4} + x + c$

$3 = x^4 + x + c$

$3 = (-1)^4 + (-1) + c$

$c = 3$

$\frac{dy}{dx} = x^4 + x + 3$

$y = \int \frac{x^5}{5} + \frac{x^2}{2} + 3x + c$

$\frac{1}{2} = \frac{-1^5}{5} + \frac{-1^2}{2} + 3(-1) + c$

$\frac{1}{2} = -\frac{27}{10} + c$

$c = \frac{16}{5}$

$y = \frac{x^5}{5} + \frac{x^2}{2} + 3x + \frac{16}{5}$ #

11 (a) Table 11 shows the probability of a binomial distribution, $X \sim B(n, p)$.
Jadual 11 *menunjukkan kebarangkalian bagi suatu taburan binomial,* $X \sim B(n, p)$.

r	0	1	2	3	4
$P(X = r)$	$\frac{16}{81}$	$\frac{7}{27}$	k	$\frac{16}{81}$	$\frac{1}{81}$

Table 11/*Jadual* 11

Find the values of n, k and p.
Cari nilai-nilai bagi n, k dan p.

[3 *marks*/3 *markah*]

(b) Given X is a continuous random variable such that $X \sim N(12.45, 9)$. Find
Diberi X ialah pemboleh ubah rawak selanjar dengan keadaan $X \sim N(12.45, 9)$. *Cari*

(i) the value of X when the z-score is 1.35.
nilai X apabila skor-z ialah 1.35.

(ii) the value of k such that $P(-k < Z < k) = 0.7881$.
nilai k dengan keadaan $P(-k < Z < k) = 0.7881$.

[4 *marks*/4 *markah*]

Answer/*Jawapan*:

(a)

$k = 1 - \frac{16}{81} - \frac{7}{27} - \frac{16}{81} - \frac{1}{81}$

$= \frac{1}{3}$ #

$n = r$

$n = 4$ #

${}^nC_r\, p^r q^{n-r} = {}^4C_4\, p^4 q^0 = \frac{1}{81} = (1)p^4(0) = \frac{1}{81}$

$p = \sqrt[4]{\frac{1}{81}}$

$= \frac{1}{3}$ #

(↳ mīn   r ↳ y = mx + c)

(b)

i) $x \sim N(12.45, 9)$

$z = \frac{x - m}{6}$

$\frac{x - 12.45}{3} = 1.35$

$x - 12.45 = 4.05$

$x = 16.5$ #

ii) $P(-k < z < k) = 0.7881$

$P(z < k) = \frac{1 - 0.7881}{2}$

$= 0.10595$

$= 1.248$ #

12 (a) Given that $\underset{\sim}{x} = 2\underset{\sim}{i} - \underset{\sim}{j}$ and $\underset{\sim}{y} = -\underset{\sim}{i} + 3\underset{\sim}{j}$, find the value of p if $2p\underset{\sim}{x} + 3\underset{\sim}{y}$ is parallel to the y-axis.

Diberi $\underset{\sim}{x} = 2\underset{\sim}{i} - \underset{\sim}{j}$ dan $\underset{\sim}{y} = -\underset{\sim}{i} + 3\underset{\sim}{j}$, cari nilai p jika $2p\underset{\sim}{x} + 3\underset{\sim}{y}$ selari dengan paksi-y.

[3 *marks*/3 *markah*]

(b) Diagram 12 shows the vectors, $\overrightarrow{OR} = \underset{\sim}{h}$, $\overrightarrow{OS} = \underset{\sim}{k}$, $\overrightarrow{OP}$ and $\overrightarrow{PQ}$, drawn on a grid of squares.

Rajah 12 menunjukkan vektor, $\overrightarrow{OR} = \underset{\sim}{h}$, $\overrightarrow{OS} = \underset{\sim}{k}$, $\overrightarrow{OP}$ dan $\overrightarrow{PQ}$, dilukis pada grid segi empat sama.

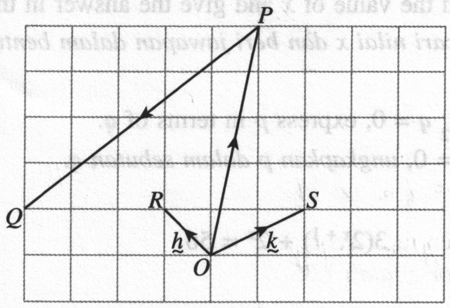


Diagram 12/*Rajah* 12

Express the following vectors in terms of $\underset{\sim}{h}$ and $\underset{\sim}{k}$.

Ungkapkan vektor yang berikut dalam sebutan $\underset{\sim}{h}$ dan $\underset{\sim}{k}$.

(i) $\overrightarrow{OP}$ (ii) $\overrightarrow{PQ}$

[2 *marks*/2 *markah*]

Answer/*Jawapan*:

(a)

$2p\underset{\sim}{x} + 3\underset{\sim}{y} = 2p(2\underset{\sim}{i} - \underset{\sim}{j}) + 3(-\underset{\sim}{i} + 3\underset{\sim}{j})$

$= 4p\underset{\sim}{i} - 2p\underset{\sim}{j} - 3\underset{\sim}{i} + 9\underset{\sim}{j}$

$= (4p - 3)\underset{\sim}{j} + (-2p + q)\underset{\sim}{i}$

$4p - 3 = 0$ $\quad -2p + q = 0$

$4p = 3$ $\quad -2(\frac{3}{4}) + q = 0$

$p = \frac{3}{4}$ $\quad q = \frac{3}{2}$

(b)

Section B
Bahagian B

[16 *marks*/16 *markah*]

Answer any **two** questions from this section.
Jawab mana-mana **dua** *soalan daripada bahagian ini.*

13 (a) If $\sqrt{6}x = \sqrt{5}x + \sqrt{5}$, find the value of x and give the answer in the form $p + \sqrt{q}$.
Jika $\sqrt{6}x = \sqrt{5}x + \sqrt{5}$, *cari nilai x dan beri jawapan dalam bentuk* $p + \sqrt{q}$.

[2 *marks*/2 *markah*]

(b) Given that $\log_8 p - \log_2 q = 0$, express p in terms of q.
Diberi $\log_8 p - \log_2 q = 0$, *ungkapkan p dalam sebutan q.*

[3 *marks*/3 *markah*]

(c) Solve the equation:
Selesaikan persamaan:

$$3(2^{x+1}) + 2^x = 56$$

[3 *marks*/3 *markah*]

Answer/*Jawapan*:

(a)

$\sqrt{6}x - \sqrt{5}x = \sqrt{5}$

$(\sqrt{6} - \sqrt{5})x = \sqrt{5}$

$x = \dfrac{\sqrt{5}}{\sqrt{6}-\sqrt{5}} \times \dfrac{\sqrt{6}+\sqrt{5}}{\sqrt{6}+\sqrt{5}}$

$\dfrac{\sqrt{30}+5}{6-5}$

$x = \sqrt{30} + 5$ #

(b)

$\dfrac{\log_2 p}{3} - \dfrac{\log_2 q}{1} = 0$

$\dfrac{\log_2 p}{3} - \dfrac{3(\log_2 p)}{3} = 0$

$\log_2\left(\dfrac{p}{q^3}\right) = 0$

$p = q^3$ #

(c)

$3[(2^x)(2^1)] + 2^x = 56$

14 A point P is moving such that it is equidistant from the points $Q(0, 2)$ and $R(4, 0)$. A point S is moving such that the distance from point $T(3, 2)$ is always 3 units.
Titik P bergerak dengan keadaan sentiasa sama jarak dari titik Q(0, 2) dan titik R(4, 0). Titik S pula bergerak dengan keadaan jaraknya dari titik T(3, 2) adalah sentiasa 3 unit.

(a) Find the equation of the locus of point P.
Cari persamaan lokus bagi titik P.

[3 marks/*3 markah*]

(b) Show that the equation of the locus of point S is $x^2 + y^2 - 6x - 4y + 4 = 0$.
Tunjukkan bahawa persamaan lokus bagi titik S ialah $x^2 + y^2 - 6x - 4y + 4 = 0$.

[2 marks/*2 markah*]

(c) Show that the midpoint of the straight line QT is not located on the locus of point S.
Buktikan bahawa titik tengah garis lurus QT tidak terletak pada lokus titik S.

[3 marks/*3 markah*]

Answer/*Jawapan*:

(a)

$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$PQ = PR$

$\sqrt{(x-0)^2 + (y-2)^2} = \sqrt{(x-4)^2 + (y-0)^2}$

$x^2 + y^2 - 4y + 4 = x^2 - 8x + 16 + y^2$

$x^2 + y^2 - 4y + 4 - x^2 + 8x - 16 - y^2 = 0$

$8x - 4y - 12 = 0$

$2x - y - 3 = 0$ #

(b)

(c)

15 (a) Find the range of values of k if the quadratic equation $x^2 + kx + 2k - 3 = 0$ does not have real roots.
Cari julat nilai k jika persamaan kuadratik $x^2 + kx + 2k - 3 = 0$ *tidak mempunyai punca nyata.*
[3 marks/*3 markah*]

(b) Given a quadratic equation $px^2 + px + 3q = 1 + 2x$ has the roots $\frac{1}{p}$ and q.

Diberi bahawa persamaan kuadratik $px^2 + px + 3q = 1 + 2x$ *mempunyai punca* $\frac{1}{p}$ *dan q.*

(i) Find the values of p and q.
Cari nilai p dan nilai q.
[3 marks/*3 markah*]

(ii) Hence, form a quadratic equation that has the roots p and $-2q$.
Seterusnya, bentukkan persamaan kuadratik yang mempunyai punca p dan –2q.
[2 marks/*2 markah*]

Answer/*Jawapan*:

(a)

(b)

END OF QUESTION PAPER

KERTAS PEPERIKSAAN TAMAT

KERTAS MODEL 4

MODEL SIJIL PELAJARAN MALAYSIA

ADDITIONAL MATHEMATICS 3472/2

Kertas 2

2 jam 30 minit **Dua jam tiga puluh minit**

1. Kertas peperiksaan ini adalah dalam dwibahasa.
2. Soalan dalam bahasa Inggeris mendahului soalan yang sepadan dalam bahasa Melayu.

INFORMATION FOR CANDIDATES
MAKLUMAT UNTUK CALON

1. This question paper consists of three sections: **Section A**, **Section B** and **Section C**.
Kertas peperiksaan ini mengandungi tiga bahagian: ***Bahagian* A**, ***Bahagian* B** *dan* ***Bahagian* C**.
2. Answer **all** the questions in **Section A**, any **three** questions from **Section B** and any **two** questions from **Section C**.
Jawab **semua** *soalan dalam* ***Bahagian* A**, *mana-mana* **tiga** *soalan daripada* ***Bahagian* B** *dan mana-mana* **dua** *soalan daripada* ***Bahagian* C**.
3. Show your working. It may help you to get marks.
Tunjukkan langkah-langkah penting dalam kerja mengira anda. Ini boleh membantu anda mendapatkan markah.
4. The diagrams provided in the questions are not drawn to scale unless stated.
Rajah yang mengiringi soalan tidak dilukis mengikut skala kecuali dinyatakan.
5. You may use a scientific calculator.
Anda dibenarkan menggunakan kalkulator saintifik.

Section A
Bahagian A

[50 *marks*/50 *markah*]

Answer **all** the questions in this section.
Jawab **semua** *soalan dalam bahagian ini.*

1 A function f is defined by $f : x \rightarrow |\, 2x - 3 \,|$ for the domain $-1 \leqslant x \leqslant 6$.
Suatu fungsi f ditakrifkan oleh $f : x \rightarrow |\, 2x - 3 \,|$ *untuk domain* $-1 \leqslant x \leqslant 6$.

(a) Sketch the graph of function f. Hence, state the range of $f(x)$ for the domain $-1 \leqslant x \leqslant 6$.
Lakarkan graf fungsi f. Seterusnya, nyatakan julat bagi $f(x)$ *untuk domain* $-1 \leqslant x \leqslant 6$.
[3 *marks*/3 *markah*]

(b) Find the values of x such that $f(x) = 3$.
Cari nilai-nilai x dengan keadaan $f(x) = 3$.
[2 *marks*/2 *markah*]

(c) Find the range of values of x such that $f(x) \leqslant 4$.
Cari julat nilai x dengan keadaan $f(x) \leqslant 4$.
[2 *marks*/2 *markah*]

2 Solve the following system of linear equations:
Selesaikan sistem persamaan linear yang berikut:

$$7x + 5y - 3z = 16$$
$$3x - 5y + 2z = -8$$
$$5x + 3y - 7z = 0$$

[7 *marks*/7 *markah*]

3 On 1 January 2020, Aiman invested an amount of RM1 200 in a bank that pays a dividend of 10% per annum if he did not withdraw after a full year. Aiman decided not to make any withdrawals from the bank until his savings exceed RM4 500.
Pada 1 *Januari* 2020, *Aiman telah melabur* RM1 200 *dalam sebuah bank yang memberikan dividen sebanyak* 10% *setahun jika dia tidak membuat pengeluaran setelah genap setahun. Aiman memutuskan untuk tidak membuat sebarang pengeluaran daripada bank itu sehinggalah simpanannya melebihi* RM4 500.

(a) Calculate the total amount of money in Aiman's bank account on 1 January 2030.
Hitung jumlah wang yang terdapat dalam akaun bank Aiman pada 1 *Januari* 2030.
[2 *marks*/2 *markah*]

(b) When will Aiman withdraw his money and how much is the exact amount he will have?
Bilakah Aiman akan mengeluarkan wangnya dan berapakah jumlah sebenar yang diperolehnya?
[5 *marks*/5 *markah*]

4 Diagram 4 shows a circle with center *O* and a radius of 9 cm. *AOC* is an arc of a circle with center *E*. Given *BD* parallel to *AC*, *BD* = 9 cm and $\angle AOC = \frac{2}{3}\pi$ rad.
Rajah 4 menunjukkan sebuah bulatan berpusat O dan berjejari 9 cm. AOC ialah satu lengkok bulatan berpusat E. Diberi BD selari dengan AC, BD = 9 cm dan $\angle AOC = \frac{2}{3}\pi$ *rad.*

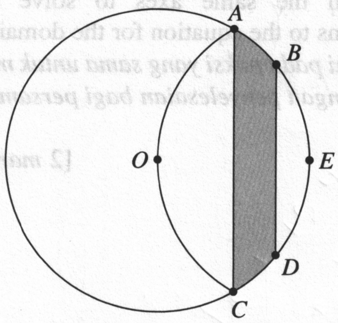


Diagram 4/*Rajah 4*

[Use/*Guna* $\pi = 3.142$]

(a) Calculate the area, in cm^2, of segment *BED*.
Hitung luas, dalam cm^2, *tembereng BED.*

[3 *marks*/3 *markah*]

(b) Show that the perimeter of the shaded region is $(9\sqrt{3} + 9 + 3\pi)$ cm.
Tunjukkan bahawa perimeter luas kawasan berlorek ialah $(9\sqrt{3} + 9 + 3\pi)$ *cm.*

[4 *marks*/4 *markah*]

5 In Diagram 5, the straight lines *PQ* and *QR* are perpendicular to each other at point *Q*. Points *P* and *Q* lie on the *x*-axis and *y*-axis respectively. Given the equation of the straight line *PQ* is $2x + 3y - 9 = 0$.
Dalam Rajah 5, garis lurus PQ dan QR berserenjang antara satu sama lain pada titik Q. Titik P dan titik Q masing-masing berada pada paksi-x dan paksi-y. Diberi persamaan garis lurus PQ ialah $2x + 3y - 9 = 0$.

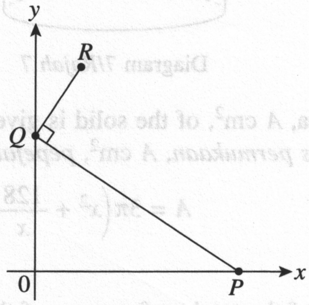


Diagram 5/*Rajah 5*

(a) Find the equation of the straight line *QR*.
Cari persamaan garis lurus QR.

[2 *marks*/2 *markah*]

(b) *RQ* is extended to cut the *x*-axis at point *S* such that *SQ* = 2*QR*. Find the coordinates of point *R*.
RQ dipanjangkan untuk memotong paksi-x pada titik S dengan keadaan SQ = 2QR. Cari koordinat titik R.

[3 *marks*/3 *markah*]

(c) Calculate the area of triangle *OQR*.
Hitung luas segi tiga OQR.

[2 *marks*/2 *markah*]

6 (a) Derive the identity $\cos 2\theta = 2\cos^2\theta - 1$.
Terbitkan identiti $\text{kos } 2\theta = 2\text{ kos}^2\theta - 1$.

[2 *marks*/2 *markah*]

(b) (i) Sketch the graph of $y = |2\cos^2\theta - 1|$ for the domain $0 \leqslant \theta \leqslant \pi$.
Lakarkan graf bagi $y = |2\text{ kos}^2\theta - 1|$ *untuk domain* $0 \leqslant \theta \leqslant \pi$.

[3 *marks*/3 *markah*]

(ii) Hence, sketch a suitable straight line graph on the same axes to solve the equation $x - 2\pi|2\cos^2\theta - 1| = 0$. State the number of solutions to the equation for the domain $0 \leqslant \theta \leqslant \pi$.
Seterusnya, lakarkan satu graf garis lurus yang sesuai pada paksi yang sama untuk menyelesaikan persamaan $x - 2\pi|2\text{ kos}^2\theta - 1| = 0$. *Nyatakan bilangan penyelesaian bagi persamaan itu untuk domain* $0 \leqslant \theta \leqslant \pi$.

[2 *marks*/2 *markah*]

7 Diagram 7 shows a solid formed by joining a cylinder and a cone. The slant height of the cone is $2x$ cm. The radius of the base of the cylinder is x cm and its volume is 192π cm^3.
Rajah 7 menunjukkan sebuah pepejal yang terbentuk daripada sebuah silinder dan sebuah kon. Tinggi sendeng kon itu ialah $2x$ cm. *Jejari tapak silinder itu ialah* x cm *dan isi padunya ialah* 192π cm^3.

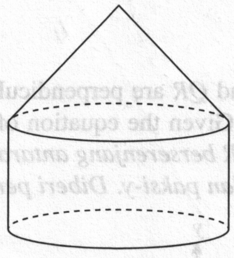


Diagram 7/*Rajah* 7

(a) Show that the total surface area, A cm^2, of the solid is given by the equation:
Tunjukkan bahawa jumlah luas permukaan, A cm^2, *pepejal itu diberi oleh persamaan*:

$$A = 3\pi\left(x^2 + \frac{128}{x}\right)$$

[3 *marks*/3 *markah*]

(b) Calculate the minimum value of the total surface area of the solid.
Hitung nilai minimum bagi jumlah luas permukaan pepejal itu.

[2 *marks*/2 *markah*]

(c) Given the surface area of the solid is increasing at a rate of 84π cm^2 s^{-1}. Find the rate of change of radius at the instant when the radius is 8 cm.
Diberi luas permukaan pepejal itu menokok pada kadar 84π cm^2 s^{-1}. *Cari kadar perubahan bagi jejari pada ketika jejarinya* 8 cm.

[3 *marks*/3 *markah*]

Section B
Bahagian B

[30 *marks*/30 *markah*]

Answer any **three** questions from this section.
Jawab mana-mana ***tiga*** *soalan daripada bahagian ini.*

8 Diagram 8 shows a plan of a school. The Laboratory is located on the straight path joining Canteen and Block *D* with a ratio of 1 : 3, while Block *B* is located at the centre between Block *A* and Block *D*. The straight path from Block *B* to Canteen and the straight path from Block *A* to Laboratory pass through the Garden.
Rajah 8 menunjukkan pelan sebuah sekolah. Makmal terletak pada jalan lurus menghubungkan Kantin dan Blok D dengan nisbah 1 : 3, *manakala Blok B terletak di tengah-tengah antara Blok A dan Blok D. Jalan lurus dari Blok B ke Kantin dan jalan lurus dari Blok A ke Makmal melalui Taman itu.*

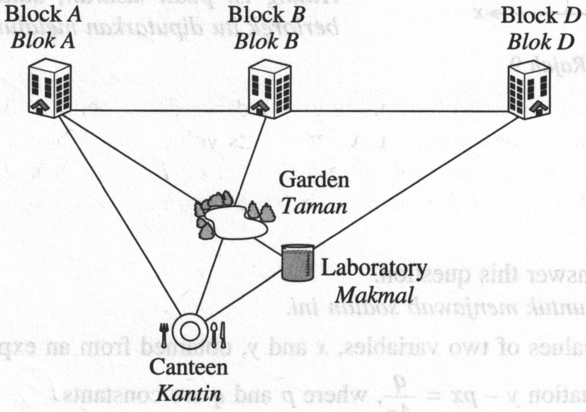


Diagram 8/*Rajah* 8

Given the vector from Canteen to Block *A* is $6\underset{\sim}{y}$, while the vector from Canteen to Block *D* is $8\underset{\sim}{x}$.
Diberi vektor dari Kantin ke Blok A ialah $6\underset{\sim}{y}$, *manakala vektor dari Kantin ke Blok D ialah* $8\underset{\sim}{x}$.

(a) Express the following in terms of $\underset{\sim}{x}$ and/or $\underset{\sim}{y}$:
Ungkapkan yang berikut dalam sebutan $\underset{\sim}{x}$ *dan/atau* $\underset{\sim}{y}$:

(i) The vector from Block *A* to Laboratory
Vektor dari Blok A ke Makmal

(ii) The vector from Canteen to Block *B*
Vektor dari Kantin ke Blok B

[3 *marks*/3 *markah*]

(b) Hence, find the ratio of the Garden's location that divides the straight path
Seterusnya, cari nisbah lokasi Taman yang membahagikan jalan lurus

(i) from Block *A* to Laboratory.
dari Blok A ke Makmal.

(ii) from Canteen to Block *B*.
dari Kantin ke Blok B.

[7 *marks*/7 *markah*]

9 Diagram 9 shows part of a curve $y = f(x)$ which passes through the point $Q(4, 2)$. The straight line PQ is parallel to the x-axis. Given the curve has a gradient function of $-2x$.
Rajah 9 menunjukkan sebahagian daripada lengkung $y = f(x)$ yang melalui titik $Q(4, 2)$. Garis lurus PQ adalah selari dengan paksi-x. Diberi lengkung itu mempunyai fungsi kecerunan $-2x$.

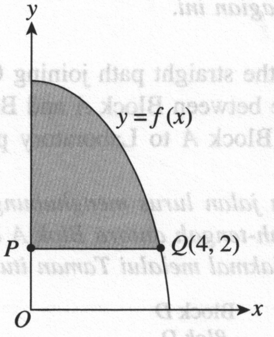


Diagram 9/*Rajah 9*

(a) Find the equation of the curve.
Cari persamaan lengkung itu.

[3 *marks*/3 *markah*]

(b) Calculate the area of the shaded region.
Hitung luas rantau berlorek.

[3 *marks*/3 *markah*]

(c) Calculate the volume of revolution, in terms if π, when the shaded region is rotated through 360° about the y-axis.
Hitung isi padu kisaran, dalam sebutan π, apabila rantau berlorek itu diputarkan melalui 360° pada paksi-y.

[4 *marks*/4 *markah*]

10 Use graph paper to answer this question.
Gunakan kertas graf untuk menjawab soalan ini.

Table 10 shows the values of two variables, x and y, obtained from an experiment. The variables x and y are related by the equation $y - px = \dfrac{q}{4x}$, where p and q are constants.
Jadual 10 menunjukkan nilai-nilai bagi dua pemboleh ubah, x dan y, yang diperoleh daripada satu eksperimen. Pemboleh ubah x dan y dihubungkan oleh persamaan $y - px = \dfrac{q}{4x}$, dengan keadaan p dan q ialah pemalar.

x	1	2	3	4	5	6
y	3.10	2.30	2.33	2.35	2.72	3.00

Table 10/*Jadual 10*

(a) Based on Table 10, construct a table for the values of x^2 and xy.
Berdasarkan Jadual 10, bina satu jadual bagi nilai-nilai x^2 dan xy.

[2 *marks*/2 *markah*]

(b) Plot xy against x^2, using a scale of 2 cm to 5 units on the x^2-axis and 2 cm to 2 units on the xy-axis. Hence, draw the line of best fit.
Plot xy melawan x^2, dengan menggunakan skala 2 cm kepada 5 unit pada paksi-x^2 dan 2 cm kepada 2 unit pada paksi-xy. Seterusnya, lukis garis lurus penyuaian terbaik.

[3 *marks*/3 *markah*]

(c) Using the graph in (b), find the values of p and q.
Dengan menggunakan graf di (b), cari nilai p dan nilai q.

[5 *marks*/5 *markah*]

11 (a) It is given that each baby born is equally likely to be either a boy or a girl.
Diberi bahawa setiap kelahiran bayi mempunyai kemungkinan sama, iaitu sama ada lelaki atau perempuan.

(i) If a family has 5 children, find the probability of having at least 3 boys.
Jika sebuah keluarga mempunyai 5 *orang anak, cari kebarangkalian bahawa keluarga itu mempunyai sekurang-kurangnya* 3 *anak lelaki.*

(ii) In a village, there are 20 families have 5 children. Find the mean and the standard deviation of the probability distribution for the number of families that are having at least 3 boys.
Di sebuah kampung, terdapat 20 *buah keluarga mempunyai* 5 *orang anak. Cari min dan sisihan piawai bagi taburan kebarangkalian untuk bilangan keluarga yang mempunyai sekurang-kurangnya* 3 *orang anak lelaki.*

[5 *marks*/5 *markah*]

(b) A study shows that the masses, in kg, of the women in a district are normally distributed with a standard deviation of 10 kg. Diagram 11 shows the graph of the normal distribution.
Suatu kajian menunjukkan bahawa jisim, dalam kg, *bagi kaum wanita di sebuah daerah bertaburan secara normal dengan sisihan piawai* 10 kg. *Rajah* 11 *menunjukkan graf bagi taburan normal itu.*

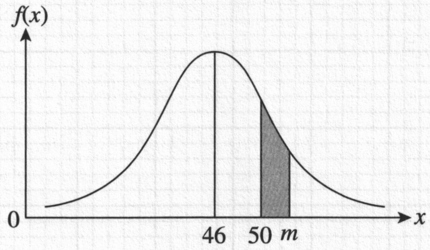


Diagram 11/*Rajah* 11

(i) Find the value of m, if the corresponding z-score is 2.
Cari nilai m, jika skor-z yang sepadan ialah 2.

(ii) If there are 6 000 women in that district, estimate the number of women who have masses between 50 kg to m kg.
Jika terdapat 6 000 *orang wanita di daerah itu, anggarkan bilangan wanita yang mempunyai jisim antara* 50 kg *hingga m* kg.

[5 *marks*/5 *markah*]

Section C
Bahagian C

[20 *marks*/20 *markah*]

Answer any **two** questions from this section.
Jawab mana-mana **dua** *soalan daripada bahagian ini.*

12 Diagram 12 shows two fixed points, O and A, on a horizontal straight line with 8 m apart. Two particles, P and Q, move along the straight line and pass through point O and point A respectively at the same instant. The velocity of particle P is $v_P = 2t - 6$, while the velocity of particle Q is $v_Q = 5 - t$, where t is the time, in seconds, after particles P and Q pass the points O and A respectively.
Rajah 12 menunjukkan dua titik tetap, O dan A, di atas satu garis lurus mengufuk dengan jarak 8 m. *Dua zarah P dan Q bergerak di sepanjang garis lurus itu dan masing-masing melalui titik O dan titik A pada ketika yang sama. Halaju zarah P ialah* $v_P = 2t - 6$, *manakala halaju zarah Q ialah* $v_Q = 5 - t$, *dengan keadaan t ialah masa, dalam saat, selepas zarah P dan zarah Q masing-masing melalui titik O dan titik A.*

[Assume the motion to the right is positive.]
[*Anggapkan gerakan ke arah kanan sebagai positif.*]

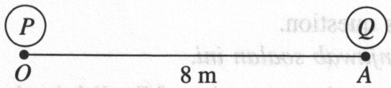


Diagram 12/*Rajah* 12

(a) Find the distance, in m, between the particles P and Q when particle P stops instantenously.
Cari jarak, dalam m, *di antara zarah P dan zarah Q apabila zarah P berhenti seketika.*

[4 *marks*/4 *markah*]

(b) Find the time, in seconds, when the distance between the particles P and Q is maximum.
Cari masa, dalam saat, apabila jarak di antara zarah P dan zarah Q adalah maksimum.

[3 *marks*/3 *markah*]

(c) Find the time, in seconds, when the particles P and Q meet. Hence, find the distance, in m, from point O when this occur.
Cari masa, dalam saat, apabila zarah P dan zarah Q bertemu. Seterusnya, cari jarak, dalam m, *dari titik O apabila pertemuan itu berlaku.*

[3 *marks*/3 *markah*]

13 Diagram 13 shows a triangle ABC.
Rajah 13 menunjukkan sebuah segi tiga ABC.

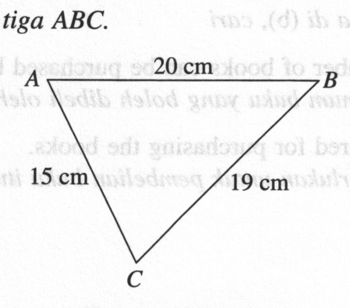


Diagram 13/*Rajah* 13

(a) Find $\angle BAC$, in degrees.
Cari $\angle BAC$, *dalam darjah.*

[2 *marks*/2 *markah*]

(b) A quadrilateral *ABCD* is formed such that *BC* is a diagonal, $\angle BCD = 30°$ and $BD = 10$ cm. Find the two possible values of $\angle BDC$.
Sebuah sisi empat ABCD dibentuk dengan keadaan BC ialah pepenjurunya, $\angle BCD = 30°$ *dan* $BD = 10$ cm. *Cari dua nilai yang mungkin bagi* $\angle BDC$.

[4 *marks*/4 *markah*]

(c) By using the acute $\angle BDC$ from (b), calculate
Dengan menggunakan $\angle BDC$ *yang tirus dari* (b), *hitung*

(i) the length of *CD*, in cm.
panjang CD, dalam cm.

[2 *marks*/2 *markah*]

(ii) the area, in cm^2, of the quadrilateral *ABCD*.
luas, dalam cm^2, *sisi empat ABCD itu.*

[2 *marks*/2 *markah*]

14 Use graph paper to answer this question.
Gunakan kertas graf untuk menjawab soalan ini.

A librarian allocates RM960 to purchase x copies of English books and y copies of Mathematics books for the library. The prices for a copy of English book and copy of Mathematics book are RM12 and RM16 respectively. The number of English books purchased is more than 10 copies. The number of Mathematics books purchased is at least 10 copies more than the English books.
Seorang pustakawan memperuntukkan RM960 *untuk membeli x buah buku Bahasa Inggeris dan y buah buku Matematik. Harga sebuah buku Bahasa Inggeris dan sebuah buku Matematik masing-masing ialah* RM12 *dan* RM16. *Bilangan buku Bahasa Inggeris yang dibeli adalah lebih daripada* 10 *buah. Bilangan buku Matematik yang dibeli sekurang-kurangnya* 10 *buah lebih daripada buku Bahasa Inggeris.*

(a) Write three linear inequalities, other than $x \geqslant 0$ and $y \geqslant 0$, that satisfy all the given conditions.
Tulis tiga ketaksamaan, selain $x \geqslant 0$ *dan* $y \geqslant 0$, *yang memuaskan semua syarat di atas.*

[3 *marks*/3 *markah*]

(b) Using a scale of 2 cm to 10 copies of books on both axes, construct and label the region *R* that satisfies all the above conditions.
Dengan menggunakan skala 2 cm *kepada* 10 *buah buku pada kedua-dua paksi, bina dan lorek rantau R yang memuaskan semua syarat di atas.*

[3 *marks*/3 *markah*]

(c) Based on the graph constructed in (b), find
Berdasarkan graf yang dibina di (b), *cari*

(i) the maximum total number of books can be purchased by the librarian.
jumlah bilangan maksimum buku yang boleh dibeli oleh pustakawan itu.

(ii) the minimum cost required for purchasing the books.
kos minimum yang diperlukan untuk pembelian buku itu.

[4 *marks*/4 *markah*]

15 Table 15 shows the price indices of three ingredients, P, Q and R, used in making a type of biscuits.
Jadual 15 *menunjukkan indeks harga bagi tiga bahan, P, Q dan R, yang digunakan untuk membuat sejenis biskut.*

Ingredient *Bahan*	**Price index in the year 2015 based on the year 2010** ***Indeks harga pada tahun 2015 berasaskan tahun 2010***	**Price index in the year 2020 based on the year 2010** ***Indeks harga pada tahun 2020 berasaskan tahun 2010***
P	128	x
Q	115	138
R	y	140

Table 15/*Jadual* 15

(a) Find the price index of ingredient Q in the year 2020 based on the year 2015.
Cari indeks harga bagi bahan Q pada tahun 2020 *berasaskan tahun* 2015.
[2 *marks*/2 *markah*]

(b) The price of ingredient P in the year 2010 is RM10.50 and its price in the year 2020 is RM14.70.
Harga bahan P pada tahun 2010 *ialah* RM10.50 *dan harganya pada tahun* 2020 *ialah* RM14.70.

(i) Find the value of x.
Cari nilai x.

(ii) Calculate the price of ingredient P in the year 2015.
Hitung harga bahan P pada tahun 2015.
[3 *marks*/3 *markah*]

(c) The composite index for the production cost of the biscuits in the year 2015 based on the year 2010 is 125. The cost of the ingredients P, Q and R used are in the ratio of 2 : 2 : 1. Find the value of y.
Indeks gubahan bagi kos pengeluaran biskut itu pada tahun 2015 *berasaskan tahun* 2010 *ialah* 125. *Kos bahan P, Q dan R yang digunakan adalah mengikut nisbah* 2 : 2 : 1. *Cari nilai y.*
[3 *marks*/3 *markah*]

(d) Given the price of a tin of the biscuits in the year 2015 is RM49.90. Find the corresponding price of the tin of biscuits in the year 2010.
Diberi harga setin biskut itu pada tahun 2015 *ialah* RM49.90. *Cari harga yang sepadan bagi setin biskut itu pada tahun* 2010.
[2 *marks*/2 *markah*]

END OF QUESTION PAPER
KERTAS PEPERIKSAAN TAMAT

PERBANDINGAN FORMAT INSTRUMEN PEPERIKSAAN SPM MATEMATIK TAMBAHAN (3472)

Kertas 1 (3472/1)

BIL.	PERKARA	FORMAT SEHINGGA 2020	FORMAT MULAI 2021
1	**Jenis Instrumen**	Ujian Bertulis	Ujian Bertulis
2	**Jenis Item**	• Objektif (Respons Diberi)	• Subjektif Respons Terhad • Subjektif Berstruktur
3	**Bilangan Soalan**	25 soalan (Jawab **semua** soalan)	**Bahagian A** 12 soalan (64 markah) (Jawab **semua** soalan) **Bahagian B** 3 soalan (16 markah) (Jawab **2** soalan)
4	**Jumlah Markah**	**80 markah**	**80 markah**
5	**Tempoh Ujian**	2 jam	2 jam
6	**Konstruk**	• Pengetahuan (20%) • Kemahiran Mengaplikasi (80%)	• Mengingat dan Memahami • Mengaplikasi • Menganalisis • Menilai • Mencipta

Kertas 2 (3472/2)

BIL.	PERKARA	FORMAT SEHINGGA 2020	FORMAT MULAI 2021
1	**Jenis Instrumen**	Ujian Bertulis	Ujian Bertulis
2	**Jenis Item**	• Subjektif Respons Terhad • Subjektif Berstruktur	• Subjektif Respons Terhad • Subjektif Berstruktur
3	**Bilangan Soalan**	**Bahagian A** 6 soalan (40 markah) (Jawab **semua** soalan) **Bahagian B** 5 soalan (40 markah) (Jawab **4** soalan) **Bahagian C** 4 soalan (20 markah) (Jawab **2** soalan)	**Bahagian A** 7 soalan (50 markah) (Jawab **semua** soalan) **Bahagian B** 4 soalan (30 markah) (Jawab **3** soalan) **Bahagian C** 4 soalan (20 markah) (Jawab **2** soalan)
4	**Jumlah Markah**	**100 markah**	**100 markah**
5	**Tempoh Ujian**	2 jam 30 minit	2 jam 30 minit
6	**Konstruk**	• Kemahiran Mengaplikasi (60%) • Penyelesaian Masalah (40%)	• Mengingat dan Memahami • Mengaplikasi • Menganalisis • Menilai • Mencipta

MATHEMATICAL FORMULAE

1 $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

2 $\log_a b = \dfrac{\log_c b}{\log_c a}$

3 $T_n = a + (n - 1)d$

4 $T_n = ar^{n-1}$

5 $S_n = \dfrac{n}{2}[2a + (n - 1)d]$

6 $S_n = \dfrac{a(r^n - 1)}{r - 1} = \dfrac{a(1 - r^n)}{1 - r}, r \neq 1$

7 $Z = \dfrac{X - \mu}{\sigma}$

8 $P(X = r) = {}^nC_r\, p^r q^{n-r}, p + q = 1$

9 ${}^nP_r = \dfrac{n!}{(n - r)!}$

10 ${}^nC_r = \dfrac{n!}{(n - r)!\, r!}$

11 $I = \dfrac{Q_1}{Q_0} \times 100$

12 $\bar{I} = \dfrac{\Sigma W_i I_i}{\Sigma W_i}$

13 $\sin^2 A + \cos^2 A = 1$
$\sin^2 A + \text{kos}^2 A = 1$

14 $\sec^2 A = 1 + \tan^2 A$
$\text{sek}^2 A = 1 + \tan^2 A$

15 $\text{cosec}^2 A = 1 + \cot^2 A$
$\text{kosek}^2 A = 1 + \text{kot}^2 A$

16 $\sin (A \pm B) = \sin A \cos B \pm \cos A \sin B$
$\sin (A \pm B) = \sin A \,\text{kos}\, B \pm \text{kos}\, A \sin B$

17 $\cos (A \pm B) = \cos A \cos B \mp \sin A \sin B$
$\text{kos}\, (A \pm B) = \text{kos}\, A \,\text{kos}\, B \mp \sin A \sin B$

18 $\tan (A \pm B) = \dfrac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$

19 $\sin 2A = 2 \sin A \cos A$
$\sin 2A = 2 \sin A \,\text{kos}\, A$

20 $\cos 2A = \cos^2 A - \sin^2 A$
$= 2 \cos^2 A - 1$
$= 1 - 2 \sin^2 A$

$\text{kos}\, 2A = \text{kos}^2 A - \sin^2 A$
$= 2\, \text{kos}^2 A - 1$
$= 1 - 2 \sin^2 A$

21 $\tan 2A = \dfrac{2 \tan A}{1 - \tan^2 A}$

22 $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

23 $a^2 = b^2 + c^2 - 2bc \cos A$
$a^2 = b^2 + c^2 - 2bc \,\text{kos}\, A$

24 Area of a triangle
Luas segi tiga
$= \dfrac{1}{2} ab \sin C$

ANSWERS

KERTAS MODEL SPM 1

Kertas 1

1 (a) $f(x) = a(x - b)^2 + c$

$b = 2, c = 5$

$f(x) = a(x - 2)^2 + 5$

$(0, 10)$: $f(0) = a(0 - 2)^2 + 5 = 10$

$4a + 5 = 10$

$4a = 5$

$a = \frac{5}{4}$

$\therefore f(x) = \frac{5}{4}(x - 2)^2 + 5$

(b) New minimum point = (–2, 5)

Titik minimum baharu = (–2, 5)

$\therefore g(x) = \frac{5}{4}(x + 2)^2 + 5$

2 (a) $f(x) = |7 - 4x| = 11$

$|7 - 4x| = 11$

$7 - 4x = 11$ or/*atau* $7 - 4x = -11$

$4x = 7 - 11$ $\quad$ $4x = 7 + 11$

$= -4$ $\quad$ $= 18$

$x = -1$ $\quad$ $x = \frac{9}{2}$

(b) $g^{-1}(15) = k$

$g(k) = 15$

$4k + 3 = 15$

$4k = 12$

$k = 3$

3 (a) $81^{2y} - 6^{2y} = (3^4)^{2y} - (3 \times 2)^{2y}$

$= (3^y)^8 - (3^y \times 2^y)^2$

$= q^8 - p^2q^2$

(b) $12^y \times 16^{y+1} = (4 \times 3)^y \times (2^4)^{y+1}$

$= (2^y)^2 \times 3^y \times (2^y)^4 \times 2^4$

$= 2^4 \times (2^y)^{2+4} \times 3^y$

$= 16p^6q$

4 $\log_2 (m + 5) = 3(\log_2 n + 2)$

$\log_2 (m + 5) = 3 \log_2 n + 6$

$\log_2 (m + 5) = \log_2 n^3 + 6$

$\log_2 (m + 5) - \log_2 n^3 = 6$

$\log_2 \frac{m+5}{n^3} = 6$

$\frac{m+5}{n^3} = 2^6$

$m + 5 = 64n^3$

$m = 64n^3 - 5$

5 (a) $a = -20$ and/*dan* $S_{14} = 175$

$\frac{14}{2}[2(-20) + (14 - 1)d] = 175$

$7(-40 + 13d) = 175$

$-40 + 13d = 25$

$13d = 65$

$d = 5$

(b) $T_{14} = -20 + 13(5)$

$= 45$

6 (a) $y = px^{3q}$

$\log_2 y = \log_2 p + \log_2 x^{3q}$

$\log_2 y = 3q \log_2 x + \log_2 p$

$\log_2 p = 3$ and/*dan* $3q = \frac{4-3}{4-0}$

$p = 2^3$ $\quad$ $3q = \frac{1}{4}$

$p = 8$ $\quad$ $q = \frac{1}{12}$

(b) $\log_2 y = \frac{1}{4} \log_2 x + 3$

When/*Apabila* $y = 6$,

$\log_2 6 = \frac{1}{4} \log_2 x + \log_2 8$

$\log_2 6 = \log_2 x^{\frac{1}{4}} + \log_2 8$

$\log_2 x^{\frac{1}{4}} = \log_2 6 - \log_2 8$

$\log_2 x^{\frac{1}{4}} = \log_2 \frac{6}{8}$

$x^{\frac{1}{4}} = \frac{3}{4}$

$x = \left(\frac{3}{4}\right)^4$

$x = \frac{81}{256}$

7 (a) $10a + 2b = 2\pi$

$5a + b = \pi$

$b = \pi - 5a$

(b) Perimeter = $(12r + 70)$ cm

$6r + 6r + 8r(10a) + 2r(2b) = 12r + 70$

$12r + 80ar + 4br = 12r + 70$

$40ar + 2br = 35$

$40ar + 2r(\pi - 5a) = 35$

$40ar + 2\pi r - 10ar = 35$

$30ar + 2\pi r = 35$

$r(30a + 2\pi) = 35$

$r = \frac{35}{30a + 2\pi}$

8 (a) $h(x) = (1 - 2x)^3$

$h'(x) = 3(1 - 2x)^2(-2)$
$= -6(1 - 2x)^2$

$h'(1) = -6[1 - 2(1)]^2$
$= -6$

(b) For/*Untuk* $y = \dfrac{x}{2x - 1}$:

$$\frac{dy}{dx} = \frac{(2x - 1)(1) - x(2)}{(2x - 1)^2}$$
$$= \frac{-1}{(2x - 1)^2}$$

(2, 3): $\dfrac{dy}{dx} = \dfrac{-1}{[2(2) - 1]^2}$
$= \dfrac{-1}{3^2}$
$= -\dfrac{1}{9}$

$m_1 \times m_2 = -1$
$-\dfrac{1}{9} \times m_2 = -1$
$m_2 = 9$

For/*Untuk* $2x + 3py = 15$:
$3py = -2x + 15$
$y = \dfrac{-2}{3p}x + \dfrac{5}{p}$

$\therefore \dfrac{-2}{3p} = 9$
$3p = -\dfrac{2}{9}$
$p = -\dfrac{2}{27}$

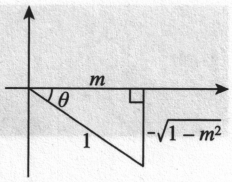
9 (a) $\displaystyle\int_6^3 \frac{1}{2}g(x)\,dx = -\int_3^6 \frac{1}{2}g(x)\,dx$
$= -\dfrac{1}{2}\left(\dfrac{7}{2}\right)$
$= -\dfrac{7}{4}$

(b) $\displaystyle\int_3^6 [g(x) - 2q]\,dx = 16$
$\displaystyle\int_3^6 g(x)\,dx - \int_3^6 2q\,dx = 16$
$\displaystyle\int_3^6 g(x)\,dx - [2qx]_3^6 = 16$
$\dfrac{7}{2} - (12q - 6q) = 16$
$\dfrac{7}{2} - 6q = 16$
$6q = -\dfrac{25}{2}$
$q = -\dfrac{25}{12}$

10 (a) $5! \times 3! = 720$

(b) ${}^4C_1 \times {}^4C_4 + {}^4C_2 \times {}^4C_3 + {}^4C_3 \times {}^4C_2 + {}^4C_4 \times {}^4C_1$
$= 56$

11 (a) $\tan \theta = -\dfrac{\sqrt{1 - m^2}}{m}$



(b) $\sin 2\theta = 2 \sin \theta \cos \theta$
$= 2(-\sqrt{1 - m^2})(m)$
$= -2m\sqrt{1 - m^2}$

$\operatorname{cosec} 2\theta = \dfrac{1}{\sin 2\theta}$
$= -\dfrac{1}{2m\sqrt{1 - m^2}}$

12 (a) $n = 5, p = 0.7, q = 0.3$

$P(X \geqslant 3)$
$= P(X = 3) + P(X = 4) + P(X = 5)$
$= {}^5C_3(0.7)^3(0.3)^2 + {}^5C_4(0.7)^4(0.3) + {}^5C_5(0.7)^5(0.3)^0$
$= 0.3087 + 0.36015 + 0.16807$
$= 0.8369$

(b) $P(X > 50) = 2.28\% = 0.0228$
$P\left(Z > \dfrac{50 - X}{5}\right) = 0.0228$
$\dfrac{50 - X}{5} = 2$
$50 - X = 10$
$X = 40$

13 (a) Perimeters of squares:
Perimeter segi empat sama:
$4k, 4(k + 2), 4(k + 4), \ldots$
$= 4k, 4k + 8, 4k + 16, \ldots$

AP/*JA*: $a = 4k, d = 8$

$S_8 = \dfrac{8}{2}[2(4k) + 7(8)] = 352$
$4(8k + 56) = 352$
$8k + 56 = 88$
$8k = 32$
$k = 4$

(b) Perimeters of squares:
Perimeter segi empat sama:
$16, 24, 32, \ldots; a = 16, d = 8$

$T_n = 56$
$16 + (n - 1)(8) = 56$
$8(n - 1) = 40$
$n - 1 = 5$
$n = 6$

The sixth square has a perimeter of 56 cm.
Segi empat sama keenam mempunyai perimeter 56 cm.

14 (a) (i) $\overrightarrow{RM} = \overrightarrow{RN} + \overrightarrow{NM}$
$= -3\underset{\sim}{x} + 8\underset{\sim}{y}$

(ii) $\overrightarrow{ML} = \overrightarrow{MN} + \overrightarrow{NL}$
$= -8\underset{\sim}{y} + 4\overrightarrow{NR}$
$= -8\underset{\sim}{y} + 4(3\underset{\sim}{x})$
$= 12\underset{\sim}{x} - 8\underset{\sim}{y}$

$\overrightarrow{NQ} = \overrightarrow{NM} + \overrightarrow{MQ}$
$= 8\underset{\sim}{y} + \frac{1}{2}\overrightarrow{ML}$
$= 8\underset{\sim}{y} + \frac{1}{2}(12\underset{\sim}{x} - 8\underset{\sim}{y})$
$= 6\underset{\sim}{x} + 4\underset{\sim}{y}$

(b) (i) $\overrightarrow{PM} = k\overrightarrow{RM}$
$= k(-3\underset{\sim}{x} + 8\underset{\sim}{y})$
$= -3k\underset{\sim}{x} + 8k\underset{\sim}{y}$

(ii) $\overrightarrow{PQ} = h\overrightarrow{NQ}$
$= h(6\underset{\sim}{x} + 4\underset{\sim}{y})$
$= 6h\underset{\sim}{x} + 4h\underset{\sim}{y}$

(iii) $\overrightarrow{MQ} = \overrightarrow{MP} + \overrightarrow{PQ}$
$\frac{1}{2}\overrightarrow{ML} = -(-3k\underset{\sim}{x} + 8k\underset{\sim}{y}) + (6h\underset{\sim}{x} + 4h\underset{\sim}{y})$
$\frac{1}{2}(12\underset{\sim}{x} - 8\underset{\sim}{y}) = 3k\underset{\sim}{x} - 8k\underset{\sim}{y} + 6h\underset{\sim}{x} + 4h\underset{\sim}{y}$
$6\underset{\sim}{x} - 4\underset{\sim}{y} = (3k + 6h)\underset{\sim}{x} + (-8k + 4h)\underset{\sim}{y}$

$3k + 6h = 6$
$k + 2h = 2$ ...... ①

$-8k + 4h = -4$
$-4k + 2h = -2$ ...... ②

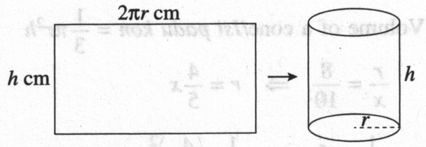
① – ②: $5k = 4$
$k = \frac{4}{5}$

From/*Dari* ①: $\frac{4}{5} + 2h = 2$
$2h = \frac{6}{5}$
$h = \frac{3}{5}$

15 (a) $A = 3\pi x^2 + \frac{48\pi}{x}$
$\frac{dA}{dx} = 6\pi x - \frac{48\pi}{x^2}$
$\frac{dA}{dt} = 18\pi \text{ cm}^2 \text{ s}^{-1}$

When/*Apabila* $x = 4$,
$\frac{dA}{dx} = 6\pi(4) - \frac{48\pi}{4^2}$
$= 21\pi$
$\frac{dx}{dt} = \frac{dx}{dA} \times \frac{dA}{dt}$
$= \frac{1}{21\pi} \times 18\pi$
$= \frac{6}{7} \text{ cm s}^{-1}$

(b)



Perimeter = 28 cm
$2(2\pi r + h) = 28$
$2\pi r + h = 14$
$h = 14 - 2\pi r$

Volume/*Isi padu*:
$V = \pi r^2 h$
$= \pi r^2(14 - 2\pi r)$
$= 14\pi r^2 - 2\pi^2 r^3$
$\frac{dV}{dr} = 28\pi r - 6\pi^2 r^2$

When V is maximum, $\frac{dV}{dr} = 0$.
Apabila V maksimum,
$28\pi r - 6\pi^2 r^2 = 0$
$2\pi r(14 - 3\pi r) = 0$
$14 - 3\pi r = 0$
$3\pi r = 14$
$r = \frac{14}{3\pi}$

Length/*Panjang* $= 2\pi r$
$= 2\pi\left(\frac{14}{3\pi}\right)$
$= 9\frac{1}{3}$ cm

Kertas 2

1 (a) Let/*Katakan*:
x = Number of tables/*Bilangan meja*
y = Number of chairs/*Bilangan kerusi*
z = Number of racks/*Bilangan rak*

$x + y + z = 28$ ...... ①
$z - y = x + 2$
$x + y - z = -2$ ...... ②
$1\,550x + 750y + 1\,250z = 33\,300$
$31x + 15y + 25z = 666$ ...... ③

(b) ① – ②: $2z = 30$
$z = 15$

From/*Dari* ①: $x + y + 15 = 28$
$x + y = 13$
$x = 13 - y$ ...... ④

From/*Dari* ③: $31x + 15y + 25(15) = 666$
$31x + 15y = 291$
$31(13 - y) + 15y = 291$
$403 - 31y + 15y = 291$
$-16y = -112$
$y = 7$

From/*Dari* ④: $x = 13 - 7 = 6$

The number of tables, chairs and racks sold are 6, 7 and 15 respectively.
Bilangan meja, kerusi dan rak yang dijual masing-masing ialah 6, 7 dan 15 buah.

2 (a) Volume of a cone/*Isi padu kon* $= \frac{1}{3}\pi r^2 h$

$\frac{r}{x} = \frac{8}{10} \Rightarrow r = \frac{4}{5}x$

$V = \frac{1}{3}\pi(8^2)(10) - \frac{1}{3}\pi\left(\frac{4}{5}x\right)^2 x$

$= \frac{640}{3}\pi - \frac{16\pi}{75}x^3$

$= \frac{16}{3}\pi\left(40 - \frac{x^3}{25}\right)$

(b) $\frac{dV}{dx} = \frac{16}{3}\pi\left(-\frac{3x^2}{25}\right) = -\frac{16}{25}\pi x^2$

$\frac{dx}{dt} = 0.5 \text{ cm s}^{-1}$

When/*Apabila* $x = 5$,

$\frac{dV}{dt} = \frac{dV}{dx} \times \frac{dx}{dt}$

$= -\frac{16}{25}\pi(5^2) \times 0.5$

$= -8\pi \text{ cm}^3 \text{ s}^{-1}$

3 (a) (i) $k(x) = 2x - 6$

Let/*Katakan* $y = k^{-1}(x)$

$k(y) = x$

$2y - 6 = x$

$2y = x + 6$

$y = \frac{x+6}{2}$

$k^{-1}(x) = \frac{x+6}{2}$

(ii) $k^2(x) = k[k(x)]$

$= k(2x - 6)$

$= 2(2x - 6) - 6$

$= 4x - 12 - 6$

$= 4x - 18$

$k^2\left(\frac{2}{3m}\right) = 4$

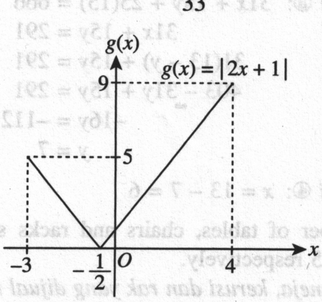
$4\left(\frac{2}{3m}\right) - 18 = 4$

$\frac{8}{3m} - 18 = 4$

$\frac{8}{3m} = 22$

$m = \frac{4}{33}$

(b)



Range/*Julat* : $0 \leqslant g(x) \leqslant 9$

4 (a) $\tan \theta = \frac{10}{4}$

$\theta = 1.1903$ rad

(b) Arc *PT*/*Lengkok PT* $= 14(1.1903)$

$= 16.664$ cm

Arc *PQ*/*Lengkok PQ* $= \frac{\pi}{2}(10)$

$= 15.71$ cm

$TQ = 14 - (\sqrt{10^2 + 4^2})$

$= 3.230$ cm

Perimeter of the shaded region

Perimeter rantau berlorek

$= 16.664 + 15.71 + 3.230$

$= 35.604$ cm

(c) Area of sector *PST*/*Luas sektor PST*

$= \frac{1}{2}(14^2)(1.1903)$

$= 116.65 \text{ cm}^2$

Area of sector *POQ*/*Luas sektor POQ*

$= \frac{1}{2}(10^2)\left(\frac{\pi}{2}\right)$

$= 78.55 \text{ cm}^2$

Area of triangle *OQS*/*Luas segi tiga OQS*

$= \frac{1}{2}(4)(10)$

$= 20 \text{ cm}^2$

Area of the shaded region/*Luas rantau berlorek*

$= 116.65 - 78.55 - 20$

$= 18.10 \text{ cm}^2$

5 (a) $ar^2 + ar^3 = \frac{400}{27}$

$ar^2(1 + r) = \frac{400}{27}$ ...... ①

$ar^3 + ar^4 = \frac{800}{81}$

$ar^3(1 + r) = \frac{800}{81}$ ...... ②

② ÷ ①: $\frac{ar^3(1+r)}{ar^2(1+r)} = \frac{800}{81} \div \frac{400}{27}$

$r = \frac{2}{3}$

(b) $a\left(\frac{2}{3}\right)^2\left(\frac{5}{3}\right) = \frac{400}{27}$

$\frac{20}{27}a = \frac{400}{27}$

$a = 20$

$T_6 = 20\left(\frac{2}{3}\right)^5$

$= \frac{640}{243}$

(c) $20\left(\frac{2}{3}\right)^{n-1} = \frac{1\,280}{729}$

$\left(\frac{2}{3}\right)^{n-1} = \frac{64}{729}$

$\left(\frac{2}{3}\right)^{n-1} = \left(\frac{2}{3}\right)^{6}$

$n - 1 = 6$

$n = 7$

6 (a) Midpoint of QS = Midpoint of PR

Titik tengah QS = Titik tengah PR

$x = \frac{-2+2}{2} = 0 \qquad y = \frac{5-3}{2} = 1$

$\therefore$ Midpoint of QS/*Titik tengah QS* = (0, 1)

For/*Untuk* $2y + x = 1$:

$y = -\frac{1}{2}x + \frac{1}{2}$

$m = -\frac{1}{2}$

Equation of QS/*Persamaan QS*:

$y - 1 = -\frac{1}{2}(x - 0)$

$y = -\frac{1}{2}x + 1$

(b) $m_{PS} = -1 \;\Rightarrow\; m_{RS} = 1$

Equation of RS/*Persamaan RS*:

$y - (-3) = 1(x - 2)$

$y + 3 = x - 2$

$y = x - 5$

(c) Solve the equations $y = x - 5$ and $y = -\frac{1}{2}x + 1$ to find point S.

Selesaikan persamaan $y = x - 5$ *dan* $y = -\frac{1}{2}x + 1$ *untuk mencari titik S.*

$x - 5 = -\frac{1}{2}x + 1$

$2x - 10 = -x + 2$

$3x = 12$

$x = 4$

$y = 4 - 5 = -1$

$\therefore S(4, -1)$

Use (0, 1) and $S(4, -1)$ to find point Q.

Gunakan (0, 1) *dan* $S(4, -1)$ *untuk mencari titik Q.*

$\frac{x+4}{2} = 0 \qquad \frac{y-1}{2} = 1$

$x + 4 = 0 \qquad y - 1 = 2$

$x = -4 \qquad y = 3$

$\therefore Q(-4, 3)$

Area of quadrilateral $PQRS$/*Luas sisi empat PQRS*

$= \frac{1}{2}\left|\begin{matrix} -2 & -4 & 2 & 4 & -2 \\ 5 & 3 & -3 & -1 & 5 \end{matrix}\right|$

$= \frac{1}{2}\left|(-6 + 12 - 2 + 20) - (-20 + 6 - 12 + 2)\right|$

$= \frac{1}{2}\left|24 - (-24)\right|$

$= 24 \text{ unit}^2$

7 (a) SOR/*HTP*: $m + n = \frac{-b}{a}$

POR/*HDP*: $mn = \frac{c}{a}$

(i) $\frac{c}{b} = \frac{c}{a} \times \frac{a}{b}$

$= mn \times \frac{-1}{m+n}$

$= \frac{-mn}{m+n}$

(ii) $\frac{a+b+c}{b} = \frac{a}{b} + 1 + \frac{c}{b}$

$= \left(\frac{-1}{m+n}\right) + 1 + \left(\frac{-mn}{m+n}\right)$

$= \frac{-1 + m + n - mn}{m+n}$

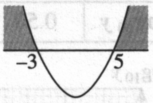
$= \frac{m + n - mn - 1}{m+n}$

(b) $15 + 2x - x^2 < 0$

$x^2 - 2x - 15 > 0$

$(x + 3)(x - 5) > 0$

$x < -3$ or/*atau* $x > 5$



8 (a) (i) $x^3 - 8 = 0$

$x^3 = 8$

$x = 2$

$\therefore r = 2$

(ii) Area of the shaded region

Luas kawasan berlorek

$= \left|\int_0^2 (x^3 - 8)\, dx\right| + \int_2^4 (x^3 - 8)\, dx$

$= \left|\left[\frac{x^4}{4} - 8x\right]_0^2\right| + \left[\frac{x^4}{4} - 8x\right]_2^4$

$= |(4 - 16) - 0| + [(64 - 32) - (4 - 16)]$

$= |-12| + [32 - (-12)]$

$= 56 \text{ unit}^2$

(b) $y = \frac{x^2}{3} \;\Rightarrow\; x^2 = 3y$

$\pi(4^2)(q) - \pi\int_0^q 3y\, dy = 34\frac{1}{2}\pi$

$16\pi q - \pi\left[\frac{3y^2}{2}\right]_0^q = 34\frac{1}{2}\pi$

$16q - \frac{3q^2}{2} = \frac{69}{2}$

$32q - 3q^2 = 69$

$3q^2 - 32q + 69 = 0$

$(3q - 23)(q - 3) = 0$

Since/*Oleh sebab* $q < 5$, $q = 3$.

9 (a) (i) $n = 8$, $p = 0.6$, $q = 0.4$

Mean/*Min* $= np$

$= 8 \times 0.6$

$= 4.8$

Variance/*Varians* $= npq$

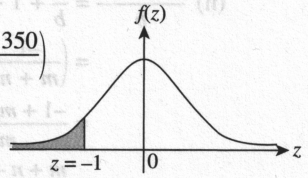
$= 8 \times 0.6 \times 0.4$

$= 1.92$

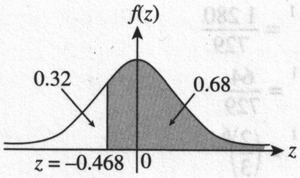
(ii) Let X = Number of male students chosen
Katakan X = Bilangan pelajar lelaki dipilih
$X \sim B(8, 0.4)$
$P(X \geqslant 3) = 1 - P(X < 3)$
$= 1 - P(X = 0) - P(X = 1) - P(X = 2)$
$= 1 - {}^8C_0 (0.4)^0 (0.6)^8 - {}^8C_1 (0.4)^1 (0.6)^7 - {}^8C_2 (0.4)^2 (0.6)^6$
$= 1 - 0.01680 - 0.08958 - 0.20902$
$= 0.6846$

(b) $X \sim N(350, 25) \Rightarrow \mu = 350, \sigma = \sqrt{25} = 5$

(i) $P(X < 345)$
$= P\left(Z < \frac{345 - 350}{5}\right)$
$= P(Z < -1)$
$= 0.1587$



(ii)



$P(X > k) = 0.68$
$P(X < k) = 0.32$

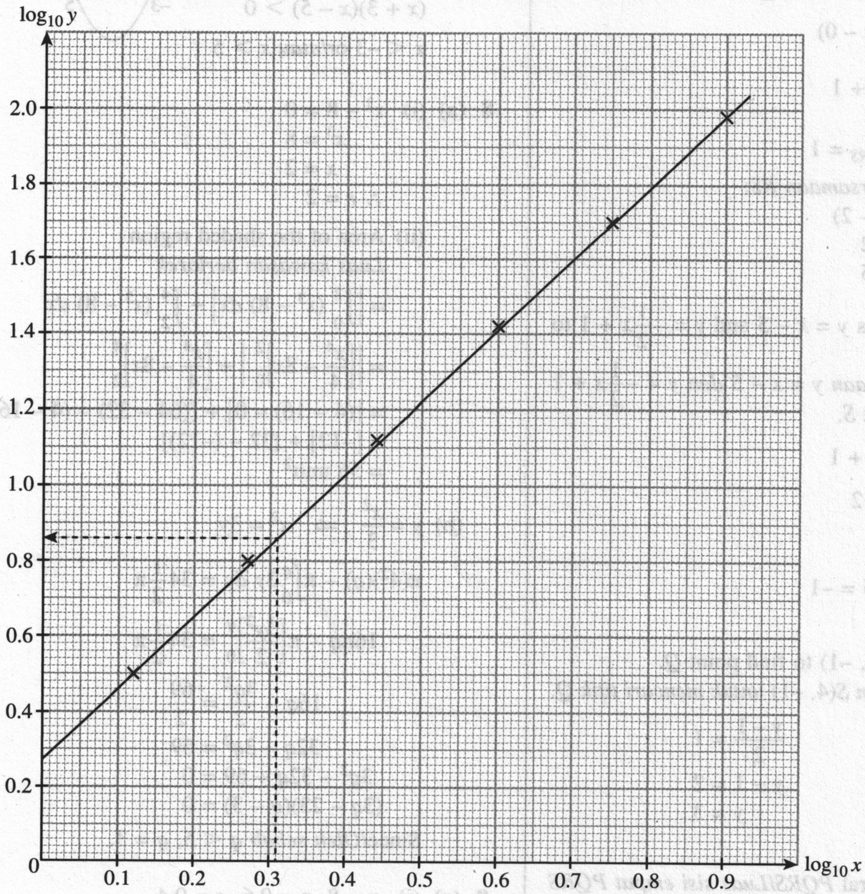
$P(Z < \frac{k - 350}{5}) = 0.32$

From the normal distribution table:
Dari jadual taburan normal:
$P(Z < -0.468) = 0.32$

$\therefore \frac{k - 350}{5} = -0.468$
$k - 350 = -2.34$
$k = 347.66$

10 (a)

$\log_{10} x$	0.12	0.27	0.44	0.60	0.75	0.90
$\log_{10} y$	0.50	0.80	1.12	1.42	1.70	1.98



(b) (i) $y = px^{\frac{k}{3}}$

$\log_{10} y = \log_{10} px^{\frac{k}{3}}$

$\log_{10} y = \log_{10} p + \log_{10} x^{\frac{k}{3}}$

$\log_{10} y = \frac{k}{3} \log_{10} x + \log_{10} p$

$Y \;=\; mX \;+\; C$

$C = \log_{10} p = 0.28$
$p = 1.905$

$m = \frac{k}{3} = \frac{1.42 - 0.28}{0.6 - 0}$

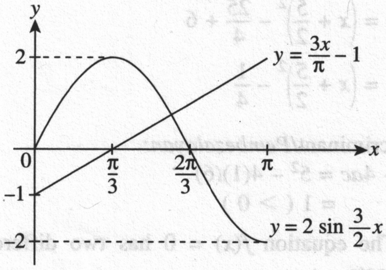
$\frac{k}{3} = 1.9$

$k = 5.7$

(ii) When/*Apabila* $x = 2.05$, $\log_{10} x = 0.31$
From the graph/*Daripada graf*:
When/*Apabila* $\log_{10} x = 0.31$,
$\log_{10} y = 0.86$
$y = 7.244$

11 (a) $2 \cot 2A = \dfrac{2}{\tan 2A}$
$= \dfrac{2}{\dfrac{2 \tan A}{1 - \tan^2 A}}$
$= 2 \times \dfrac{1 - \tan^2 A}{2 \tan A}$
$= \dfrac{1 - \tan^2 A}{\tan A}$
$= \dfrac{1}{\tan A} - \dfrac{\tan^2 A}{\tan A}$
$= \cot A - \tan A$

(b) (i), (ii)



$\sin \dfrac{3}{2}x = \dfrac{3x}{2\pi} - \dfrac{1}{2}$

$2 \sin \dfrac{3}{2}x = \dfrac{3x}{\pi} - 1$

The suitable straight line to be drawn is:
Garis lurus yang sesuai dilukis ialah:

$y = \dfrac{3x}{\pi} - 1$

When/*Apabila* $x = 0$, $y = -1$.
When/*Apabila* $x = \pi$, $y = 2$.
Number of solution/*Bilangan penyelesaian* = 1

12 (a) $v = t^2 - 8t + 7$
When/*Apabila* $t = 0$,
Initial velocity/*Halaju awal* $= 0^2 - 8(0) + 7$
$= 7 \text{ m s}^{-1}$

(b) When/*Apabila* $v = 0$,
$t^2 - 8t + 7 = 0$
$(t - 1)(t - 7) = 0$
$t = 1$ or/*atau* $t = 7$

(c) $a = \dfrac{dv}{dt} = 2t - 8$
When/*Apabila* $\dfrac{dv}{dt} = 0$,
$2t - 8 = 0$
$t = 4$

Minimum velocity/*Halaju minimum*
$= 4^2 - 8(4) + 7$
$= -9 \text{ m s}^{-1}$

(d) Total distance travelled/*Jumlah jarak yang dilalui*
$= \int_0^1 (t^2 - 8t + 7)\, dt + \left| \int_1^7 (t^2 - 8t + 7)\, dt \right|$
$= \left[\dfrac{t^3}{3} - 4t^2 + 7t \right]_0^1 + \left| \left[\dfrac{t^3}{3} - 4t^2 + 7t \right]_1^7 \right|$
$= \left| \left(\dfrac{1}{3} - 4 + 7 \right) - 0 \right| + \left| \left(\dfrac{343}{3} - 196 + 49 \right) - \left(\dfrac{1}{3} - 4 + 7 \right) \right|$
$= \dfrac{10}{3} + |-36|$
$= 39\dfrac{1}{3}$ m

13 (a) $P: 180 \times 110\% = 198$
$Q: 145$
$R: 125 \times 95\% = 118.75$

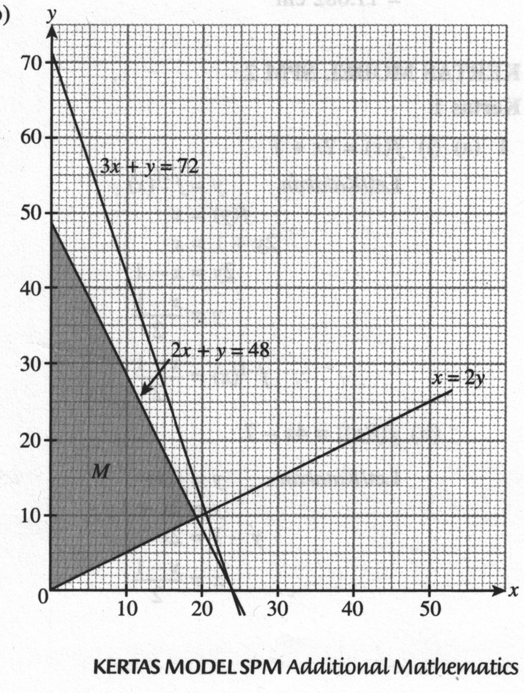
(b) $\dfrac{250}{Q_{2014}} \times 100 = 145$
$Q_{2014} = \dfrac{250 \times 100}{145}$
= RM172.41

(c) $\dfrac{Q_{2019}}{500} \times 100 = 118.75$
$Q_{2019} = \dfrac{118.75 \times 500}{100}$
= RM593.75

(d) Composite index/*Indeks gubahan*
$= \dfrac{198 \times 150 + 145 \times 120 + 118.75 \times 90}{360}$
$= \dfrac{57\ 787.5}{360}$
$= 160.52$

14 (a) I : $30x + 10y \leqslant 12 \times 60$
$3x + y \leqslant 72$
II : $20x + 10y \leqslant 8 \times 60$
$2x + y \leqslant 48$
III : $x \leqslant 2y$

(b)



(c) (i) 19 units

(ii) When/*Apabila* $x = 5$,
the range of values of y is $3 \leqslant y \leqslant 38$.
julat nilai y ialah $3 \leqslant y \leqslant 38$.

Maximum/*Maksimum* : 38 units
Minimum/*Minimum* : 3 units

(iii) Production cost/*Kos penghasilan* $= 500x + 600y$
Optimum point/*Titik optimum* = (19, 10)

Maximum production cost
Kos penghasilan maksimum
$= 500(19) + 600(10)$
= RM15 500

15 (a) $\frac{1}{2}(9.5)(BC) \sin 30° = 28$

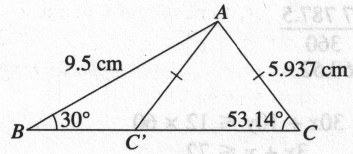
$$BC = \frac{28 \times 2}{9.5 \sin 30°} = 11.789 \text{ cm}$$

$$AC^2 = 9.5^2 + 11.789^2 - 2(9.5)(11.789) \cos 30° = 35.249$$
$$AC = 5.937 \text{ cm}$$

(b) $\frac{\sin \angle ACB}{9.5} = \frac{\sin 30°}{5.937}$

$$\sin \angle ACB = \frac{9.5 \sin 30°}{5.937}$$
$$\angle ACB = 53.14°$$

(c) (i)



(ii) Area of $\Delta ABC'$/*Luas* $\Delta ABC'$
$= \frac{1}{2}(9.5)(5.937) \sin (53.14° - 30°)$
$= 11.082 \text{ cm}^2$

KERTAS MODEL SPM 2

Kertas 1

1 (a) (i) $f(x) = 2x + 1$

Let/*Katakan* $y = f^{-1}(x)$
$$f(y) = x$$
$$2y + 1 = x$$
$$2y = x - 1$$
$$y = \frac{x-1}{2}$$
$$\therefore \ f^{-1}(x) = \frac{x-1}{2}$$

(ii) $g[f(x)] = 4x - 7$

Let/*Katakan* $y = f(x)$
$$y = 2x + 1$$
$$y - 1 = 2x$$
$$x = \frac{y-1}{2}$$
$$g(y) = 4\left(\frac{y-1}{2}\right) - 7$$
$$= 2y - 2 - 7$$
$$= 2y - 9$$
$$\therefore \ g(x) = 2x - 9$$

(b) (i) $f(-4) = |-4 + 3|$
$= |-1|$
$= 1$

(ii) $f(x) = 2$
$|x + 3| = 2$

$x + 3 = 2$ or/*atau* $x + 3 = -2$
$x = -1$ $\qquad x = -5$

2 (a) $f(x) = (x + 2)(x + 3)$
$$= x^2 + 5x + 6$$
$$= x^2 + 5x + \left(\frac{5}{2}\right)^2 - \left(\frac{5}{2}\right)^2 + 6$$
$$= \left(x + \frac{5}{2}\right)^2 - \frac{25}{4} + 6$$
$$= \left(x + \frac{5}{2}\right)^2 - \frac{1}{4}$$

(b) Discriminant/*Pembezalayan:*
$b^2 - 4ac = 5^2 - 4(1)(6)$
$= 1 \ (> 0)$

$\therefore$ The equation $f(x) = 0$ has two different real roots.
Persamaan $f(x) = 0$ *mempunyai dua punca nyata yang berbeza.*

3 (a) $d = -16$
$p = -255 - (-16) = -239$
$q = -287 + (-16) = -303$

(b) $a = -239$, $d = -16$
$T_7 = -239 + 6(-16) = -335$
$T_{10} = -239 + 9(-16) = -383$
$T_7 + T_{10} = -335 + (-383)$
$= -718$

4 (a) ${}^nP_r = {}^{n-2}P_r$
$$\frac{n!}{(n-r)!} = \frac{(n-2)!}{(n-2-r)!}$$
$$n!\,(n-2-r)! = (n-2)!\,(n-r)!$$
$$n(n-1)\cancel{(n-2)!}\,\cancel{(n-2-r)!} = \cancel{(n-2)!}\,(n-r)(n-r-1)\cancel{(n-r-2)!}$$
$$n(n-1) = (n-r)(n-r-1)$$
$$n^2 - n = n^2 - nr - n - nr + r^2 + r$$
$$0 = -2nr + r^2 + r$$
$$2nr = r + r^2$$
$$2n = 1 + r$$
$$n = \frac{1+r}{2}$$

(b) (i) $8! = 40\ 320$

(ii) ${}^3C_2 \times {}^5C_3 = 3 \times 10$
$= 30$

5 Let the roots of the equation be α and 2α.
Katakan punca persamaan ialah α dan 2α.

SOR/*HTP*: $\alpha + 2\alpha = -\frac{12}{1}$
$3\alpha = -12$
$\alpha = -4$

POR/*HDP*: $\alpha(2\alpha) = m$
$2\alpha^2 = m$
$2(-4)^2 = m$
$m = 32$

$\therefore$ The roots of the equation are -4 and -8.
Punca-punca persamaan ialah -4 dan -8.

6 (a) $3^{m+4} + 3^m - 45(3^{m-2})$
$= 3^m \cdot 3^4 + 3^m - 45\left(\frac{3^m}{3^2}\right)$
$= 3^m(3^4) + 3^m - \frac{45}{3^2}(3^m)$
$= 3^m(3^4 + 1 - 5)$
$= 3^m(77)$

Since $3^m(77)$ is divisible by 11 for all the positive integers of m, $3^{m+4} + 3^m - 45(3^{m-2})$ is also divisible by 11 for all the positive integers of m.
Oleh sebab $3^m(77)$ boleh dibahagi tepat dengan 11 bagi semua integer positif m, maka $3^{m+4} + 3^m - 45(3^{m-2})$ juga boleh dibahagi tepat dengan 11 bagi semua integer positif m.

(b) $\frac{7+\sqrt{5}}{7-\sqrt{5}} \times \frac{7+\sqrt{5}}{7+\sqrt{5}} = \frac{49 + 7\sqrt{5} + 7\sqrt{5} + 5}{49 - 5}$
$= \frac{54 + 14\sqrt{5}}{44}$
$= \frac{27 + 7\sqrt{5}}{22}$

7 (a) $\frac{dy}{dx} = 3x^2 + 5$
$y = \int (3x^2 + 5)\, dx$
$y = x^3 + 5x + c$
$(2, 6)$: $6 = 2^3 + 5(2) + c$
$6 = 8 + 10 + c$
$c = -12$

Equation of the curve/*Persamaan lengkung*:
$y = x^3 + 5x - 12$

(b) Gradient of tangent/*Kecerunan tangen* $= 3(2^2) + 5$
$= 17$

Equation of the tangent/*Persamaan tangen*:
$y - 6 = 17(x - 2)$
$y - 6 = 17x - 34$
$y = 17x - 28$

8 (a) $\tan a = \frac{8}{8} = 1$
$a = 45°$
$= 45° \times \frac{\pi}{180°}$
$= 0.7855$

(b) Arc *PQ*/*Lengkok PQ* $= 8\left(\frac{\pi}{2}\right)$
$= 12.568$ cm

Arc *RS*/*Lengkok RS* $= 8(\pi - 0.7855)$
$= 18.852$ cm

$RS^2 = 8^2 + 8^2 - 2(8)(8) \cos 135°$
$RS = 14.782$ cm

Total perimeter/*Jumlah perimeter*
$= (8 + 8 + 12.568) + (18.852 + 14.782)$
$= 62.20$ cm

(c) Total area/*Jumlah luas*
= Area of quadrant *PRQ* + Area of segment *RS*
Luas sukuan bulatan PRQ + Luas tembereng RS
$= \frac{1}{4}\pi(8^2) + \frac{1}{2}(8^2)(2.3565 - \sin 135°)$
$= 50.272 + 52.781$
$= 103.05 \text{ cm}^2$

9 (a) (i) Point *A* is the *y*-intercept. So, $x = 0$.
Titik A ialah pintasan-y. Maka, $x = 0$.
$y = 2(0^2) - 8(0) + 1 = 1$
$\therefore A(0, 1)$
$y = 2x^2 - 8x + 1$
$\frac{dy}{dx} = 4x - 8$
$= 4(0) - 8$
$= -8$

$\therefore$ The gradient of the tangent to the curve at point *A* is -8.
Kecerunan tangen kepada lengkung itu di titik A ialah -8.

(ii) $m_1 \times m_2 = -1$
$-8 \times m_2 = -1$
$m_2 = \frac{1}{8}$

The gradient of the normal to the curve at point *A* is $\frac{1}{8}$.
Kecerunan normal kepada lengkung itu di titik A ialah $\frac{1}{8}$.

Equation of the normal/*Persamaan normal*:
$y - 1 = \frac{1}{8}(x - 0)$
$y = \frac{1}{8}x + 1$
$8y = x + 8$

(b) $\int_2^8 \frac{ax^5 + 8x^2}{x^4}\, dx = 2a - 5$
$\int_2^8 ax\, dx + \int_2^8 8x^{-2}\, dx = 2a - 5$
$\left[\frac{ax^2}{2}\right]_2^8 + \left[\frac{8x^{-1}}{-1}\right]_2^8 = 2a - 5$
$(32a - 2a) + [-1 - (-4)] = 2a - 5$
$30a + 3 = 2a - 5$
$28a = -8$
$a = -\frac{2}{7}$

10 (a) (5, 8): $8 = \dfrac{12(5)}{5 + 5q}$

$40 + 40q = 60$

$40q = 20$

$q = \dfrac{1}{2}$

(b) $y = \dfrac{12x}{5 + \frac{1}{2}x}$

$y\left(5 + \frac{1}{2}x\right) = 12x$

$\dfrac{y\left(5 + \frac{1}{2}x\right)}{xy} = \dfrac{12x}{xy}$

$\dfrac{5}{x} + \dfrac{1}{2} = \dfrac{12}{y}$

$\dfrac{1}{y} = \dfrac{5}{12}\left(\dfrac{1}{x}\right) + \dfrac{1}{24}$

$Y = \; mX \; + C$

$B(u, 9)$: $9 = \dfrac{5}{12}u + \dfrac{1}{24}$

$\dfrac{215}{24} = \dfrac{5}{12}u$

$u = 21\dfrac{1}{2}$

$C(2, v)$: $v = \dfrac{5}{12}(2) + \dfrac{1}{24}$

$= \dfrac{7}{8}$

11 $\log_{\sqrt{x}} 405x^2 = \log_{\sqrt{x}} 405 + \log_{\sqrt{x}} x^2$

$= \dfrac{\log_x 405}{\log_x \sqrt{x}} + \dfrac{\log_x x^2}{\log_x \sqrt{x}}$

$= \dfrac{\log_x 81(5)}{\frac{1}{2}} + \dfrac{2 \log_x x}{\frac{1}{2}}$

$= 2(\log_x 3^4 + \log_x 5) + 2(2)$

$= 8 \log_x 3 + 2 \log_x 5 + 4$

$= 8a + 2b + 4$

12 (a) $P(0 \leqslant Z \leqslant k) = 0.17$

$P(Z \geqslant k) = 0.5 - 0.17 = 0.33$

From the normal distribution table:
Dari jadual taburan normal:
$P(Z > 0.44) = 0.33$

$\therefore k = 0.44$

(b) $\dfrac{X - \mu}{\sigma} = k$

$\dfrac{60 - \mu}{3} = 0.44$

$60 - \mu = 1.32$

$\mu = 58.68$

13 (a) $m_{PQ} = \dfrac{0 + 6}{-3 - 0} = -2$

$m_1 m_2 = -1$

$-2 \times m_2 = -1$

$m_2 = \dfrac{1}{2}$

$y - (-6) = \dfrac{1}{2}[x - (-4)]$

$y + 6 = \dfrac{1}{2}(x + 4)$

$y = \dfrac{1}{2}x - 4$

(b) Area of ΔPQR/*Luas* ΔPQR

$= \dfrac{1}{2}\begin{vmatrix} -3 & -4 & 0 & -3 \\ 0 & -6 & -6 & 0 \end{vmatrix}$

$= \dfrac{1}{2}\left|(18 + 24) - 18\right|$

$= 12 \text{ unit}^2$

Area of ΔOPQ/*Luas* $\Delta OPQ = \dfrac{1}{2}(3)(6)$

$= 9 \text{ unit}^2$

Ratio/*Nisbah* $= 12 : 9$

$= 4 : 3$

(c) $2SP = SQ$

$2\sqrt{(x - 0)^2 + (y + 6)^2} = \sqrt{(x + 3)^2 + (y - 0)^2}$

$4(x^2 + y^2 + 12y + 36) = x^2 + 6x + 9 + y^2$

$4x^2 + 4y^2 + 48y + 144 = x^2 + 6x + 9 + y^2$

$3x^2 + 3y^2 - 6x + 48y + 135 = 0$

$x^2 + y^2 - 2x + 16y + 45 = 0$

14 (a) (i) $\overrightarrow{AB} = \begin{pmatrix} 8 \\ -6 \end{pmatrix}$

(ii) $\left|\overrightarrow{AB}\right| = \sqrt{8^2 + (-6)^2}$

$= 10$ units

(b) (i) $\overrightarrow{AD} = \overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CD}$

$-5\mathbf{a} + \left(\dfrac{p + 3}{2}\right)\mathbf{b} = q\mathbf{a} + q\mathbf{b} - p\mathbf{a}$

$-5\mathbf{a} + \left(\dfrac{p + 3}{2}\right)\mathbf{b} = (q - p)\mathbf{a} + q\mathbf{b}$

$-5 = q - p$

$p = q + 5$

$\dfrac{p + 3}{2} = q$

$p + 3 = 2q$

$(q + 5) + 3 = 2q$

$5 + 3 = 2q - q$

$q = 8$

$p = 8 + 5 = 13$

(ii) $\dfrac{1}{2} \times |\overrightarrow{DC}| \times 4 = 52$

$|\overrightarrow{DC}| = 26$

$13\,|\mathbf{a}| = 26$

$|\mathbf{a}| = 2$ units

15 (a) (i) $X \sim B(3, m)$

$$P(X = 0) = 0.008$$
$$^3C_0\,(m)^0(1 - m)^3 = 0.008$$
$$(1 - m)^3 = 0.008$$
$$1 - m = 0.2$$
$$m = 0.8$$

(ii) Number of workers/*Bilangan pekerja*
$= (1 - 0.8) \times 75$
$= 0.2 \times 75$
$= 15$

(b) (i) $\mu = 3.0$ kg

$$-0.4 = \frac{2.8 - 3.0}{\sigma}$$
$$-0.4\sigma = -0.2$$
$$\sigma = 0.5$$

Variance/*Varians* $= \sigma^2 = 0.25$

(ii) $$P(X > n) = \frac{360}{600} = 0.6$$

$$P\left(Z > \frac{n - 3.0}{0.5}\right) = 0.6$$

From the normal distribution table:
Dari jadual taburan normal:

$P(Z > -0.253) = 0.6$

$$\therefore\ \frac{n - 3.0}{0.5} = -0.253$$
$$n - 3.0 = -0.1265$$
$$n = 2.8735$$

Kertas 2

1 Let/*Katakan*:
x = Number of banana cakes/*Bilangan kek pisang*
y = Number of carrot cakes/*Bilangan kek lobak merah*
z = Number of chocolate cakes/*Bilangan kek coklat*

$x + y + z = 245$ …… ①

$20x + 30y + 40z = 7\ 750$
$2x + 3y + 4z = 775$ …… ②

$(25 - 20)x + (35 - 30)y + (50 - 40)z = 1\ 725$
$5x + 5y + 10z = 1\ 725$
$x + y + 2z = 345$ …… ③

③ − ①: $z = 100$
2 × ③: $2x + 2y + 4z = 690$ …… ④
② − ④: $y = 85$
From/*Dari* ①: $x + 85 + 100 = 245$
$x = 60$

∴ Banana cake/*Kek pisang*: 60
Carrot cake/*Kek lobak merah*: 85
Chocolate cake/*Kek coklat*: 100

2 (a) Scheme I/*Skim I*:
Arithmetic progression/*Janjang aritmetik*
$a = 12 \times$ RM1 500 = RM18 000
$d = 12 \times$ RM250 = RM3 000

$$S_{10} = \frac{10}{2}[2(18\ 000) + 9(3\ 000)]$$
$= $ RM315 000

Scheme II/*Skim II*:
Geometric progression/*Janjang geometri*
a = RM20 000
$d = 1.02$

$$S_{10} = \frac{20\ 000(1.02^{10} - 1)}{1.02 - 1}$$
= RM218 994.42
= RM218 994

∴ Farhan should choose Scheme I.
Farhan patut memilih Skim I.

Savings/*tabungan* $= \frac{30}{100} \times$ RM315 000
= RM94 500

(b) Monthly salary for the 6th year
Gaji bulanan untuk tahun ke-6
$= 1\ 500 + (6 - 1) \times 250$
= RM2 750

Monthly salary for the 7th year
Gaji bulanan untuk tahun ke-7
$= 2\ 750 + 300$
= RM3 050

Let/*Katakan* $a = 3\ 050$, $d = 300$

Monthly salary for the 10th year
Gaji bulanan untuk tahun ke-10
$= 3\ 050 + (4 - 1) \times 300$
= RM3 950

3 (a) $\tan 3x = \tan(2x + x)$

$$= \frac{\tan 2x + \tan x}{1 - \tan 2x \tan x}$$

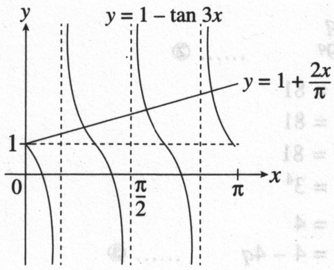
$$= \frac{\left(\frac{2\tan x}{1 - \tan^2 x}\right) + \tan x}{1 - \left(\frac{2\tan x}{1 - \tan^2 x}\right)\tan x}$$

$$= \frac{\frac{2\tan x + \tan x - \tan^3 x}{1 - \tan^2 x}}{1 - \frac{2\tan^2 x}{1 - \tan^2 x}}$$

$$= \frac{3\tan x - \tan^3 x}{1 - \tan^2 x} \times \frac{1 - \tan^2 x}{1 - \tan^2 x - 2\tan^2 x}$$

$$= \frac{3\tan x - \tan^3 x}{1 - 3\tan^2 x}$$

(b) (i), (ii)



$$\frac{2x}{\pi} + \frac{3\tan x - \tan^3 x}{1 - 3\tan^2 x} = 0$$

$$\frac{2x}{\pi} + \tan 3x = 0$$

$$\tan 3x = -\frac{2x}{\pi}$$

$$1 - \tan 3x = 1 - \left(-\frac{2x}{\pi}\right)$$

$$1 - \tan 3x = 1 + \frac{2x}{\pi}$$

The suitable straight line to be drawn is:
Garis lurus yang sesuai dilukis ialah:

$$y = 1 + \frac{2x}{\pi}$$

When/*Apabila* $x = 0$, $y = 1$.
When/*Apabila* $x = \pi$, $y = 3$.
Number of solutions/*Bilangan penyelesaian* = 4

4 (a) $\angle AOD = 2 \times 40°$
$= 80°$
$= 1.396$ rad

(b) Perimeter of the shaded region
Perimeter kawasan berlorek
= Arc/*Lengkok* $DEA + DC + AC$
$= 8(1.396) + 16 \cos 40° + 16$
$= 11.168 + 12.257 + 16$
$= 39.43$ cm

(b) Area of the shaded region
Luas kawasan berlorek
= Area of sector $OAED$ + Area of ΔOCD
Luas sektor OAED + Luas ΔOCD
$= \frac{1}{2}(8^2)(1.396) + \frac{1}{2}(8^2) \sin 100°$
$= 44.672 + 31.514$
$= 76.19 \text{ cm}^2$

5 (a) When/*Apabila* $x = 1$,
$2^{3x} - 4x \cdot 2^x + 2^x - 2$
$= 2^{3(1)} - 4(1) \cdot 2^1 + 2^1 - 2$
$= 8 - 4(2) + 2 - 2$
$= 0$

Since LHS = RHS = 0, $x = 1$ is a solution to the equation.
Oleh sebab S. Kiri = S. Kanan = 0, $x = 1$ ialah satu penyelesaian bagi persamaan itu.

(b) $\log_3 x = p$
$x = 3^p$ …… ①

$\log_9 y = q$
$y = 9^q$ …… ②

$xy^2 = 81$
$(3^p)(9^q)^2 = 81$
$(3^p)(3^{2q})^2 = 81$
$3^{p + 4q} = 3^4$

$p + 4q = 4$
$p = 4 - 4q$ …… ③

$$\frac{x^2}{y} = \frac{1}{3}$$

$$\frac{(3p)^2}{9^q} = \frac{1}{3}$$

$$3^{2p} = \frac{3^{2q}}{3}$$

$$3^{2p} = 3^{2q - 1}$$

$2p = 2q - 1$ …… ④

Substitute ③ into ④.
Gantikan ③ ke dalam ④.
$2(4 - 4q) = 2q - 1$
$8 - 8q = 2q - 1$
$-10q = -9$
$q = \frac{9}{10}$

From/*Dari* ③: $p = 4 - 4\left(\frac{9}{10}\right)$
$= \frac{2}{5}$

6 (a) $\frac{dy}{dx} = 2x - 7$
$y = \int (2x - 7)\, dx$
$y = x^2 - 7x + c$
$(5, 0)$: $0 = 5^2 - 7(5) + c$
$c = 10$
$\therefore y = x^2 - 7x + 10$

(b) $4 = 2h + 2$
$2h = 2$
$h = 1$

(c) Area of the shaded region/*Luas kawasan berlorek*
$= \int_0^1 (x^2 - 7x + 10)\, dx - \frac{1}{2}(2 + 4)(1)$
$= \left[\frac{x^3}{3} - \frac{7x^2}{2} + 10x\right]_0^1 - 3$
$= \left(\frac{1}{3} - \frac{7}{2} + 10\right) - 3$
$= 3\frac{5}{6} \text{ unit}^2$

7 (a) $AP = \sqrt{32}$
$\sqrt{(h - 5)^2 + (2h - 6)^2} = \sqrt{32}$
$(h^2 - 10h + 25) + (4h^2 - 24h + 36) = 32$
$5h^2 - 34h + 61 = 32$
$5h^2 - 34h + 29 = 0$
$(5h - 29)(h - 1) = 0$

Ignore/*Abaikan* $h = \frac{29}{5}$.
$\therefore h = 1$

$P(1, 2)$: $\frac{k - 0}{-2 - 3} = \frac{2 - 0}{1 - 3}$
$\frac{k}{-5} = -1$
$k = 5$

(b) Use/*Guna* $m_1 m_2 = -1$.

$$m_{AP} \times m_{BP} = \left(\frac{6-2}{5-1}\right)\left(\frac{0-2}{3-1}\right)$$
$$= \left(\frac{4}{4}\right)\left(\frac{-2}{2}\right)$$
$$= -1$$

AP and BD are perpendicular. Thus, AP is the shortest distance.
AP dan BD adalah berserenjang. Maka, AP adalah jarak terpendek.

8 (a) $\overrightarrow{AK} = \overrightarrow{AD} + \overrightarrow{DK}$
$$= \mathbf{q} + \frac{3}{4}(8\mathbf{p})$$
$$= 6\mathbf{p} + \mathbf{q}$$
$$\overrightarrow{JC} = \overrightarrow{JB} + \overrightarrow{BC}$$
$$= \frac{1}{4}(8\mathbf{p}) + \mathbf{q}$$
$$= 2\mathbf{p} + \mathbf{q}$$

(b) $\overrightarrow{JL} = \overrightarrow{JA} + \overrightarrow{AL}$
$$= \overrightarrow{JA} + \frac{3}{2}\overrightarrow{AK}$$
$$= -6\mathbf{p} + \frac{3}{2}(6\mathbf{p} + \mathbf{q})$$
$$= 3\mathbf{p} + \frac{3}{2}\mathbf{q}$$
$$= \frac{3}{2}(2\mathbf{p} + \mathbf{q})$$
$$= \frac{3}{2}\overrightarrow{JC}$$

$\therefore$ The points J, C and L are collinear.
Titik J, C dan L adalah segaris.

(c) (i) $\overrightarrow{JC} = 2\mathbf{p} + \mathbf{q}$
$$= 2(3\mathbf{i}) + (2\mathbf{i} + 5\mathbf{j})$$
$$= 8\mathbf{i} + 5\mathbf{j}$$

(ii) $\left|\overrightarrow{JC}\right| = \sqrt{8^2 + 5^2} = \sqrt{89}$ units

Unit vector in the direction of $\overrightarrow{JC}$
Vektor unit dalam arah $\overrightarrow{JC}$
$$= \frac{\overrightarrow{JC}}{\left|\overrightarrow{JC}\right|}$$
$$= \frac{8\mathbf{i} + 5\mathbf{j}}{\sqrt{89}}$$
$$= \frac{8}{\sqrt{89}}\mathbf{i} + \frac{5}{\sqrt{89}}\mathbf{j}$$

9 (a) (i) Let X = Number of type A oranges
Katakan X = Bilangan oren jenis A
$$X \sim B\left(8, \frac{5}{8}\right)$$
$$P(X = 7) = {}^8C_7\left(\frac{5}{8}\right)^7\left(\frac{3}{8}\right)^1 = 0.1118$$

(ii) Let Y = Number of type B oranges
Katakan Y = Bilangan oren jenis B
$$Y \sim B\left(8, \frac{3}{8}\right)$$
$$P(Y \geqslant 2) = 1 - P(Y < 2)$$
$$= 1 - P(Y = 0) - P(Y = 1)$$
$$= 1 - {}^8C_0\left(\frac{3}{8}\right)^0\left(\frac{5}{8}\right)^8 - {}^8C_1\left(\frac{3}{8}\right)^1\left(\frac{5}{8}\right)^7$$
$$= 1 - 0.02328 - 0.1118$$
$$= 0.8649$$

(b) $X \sim N(90, 12^2) \quad \Rightarrow \quad \mu = 90, \sigma = 12$

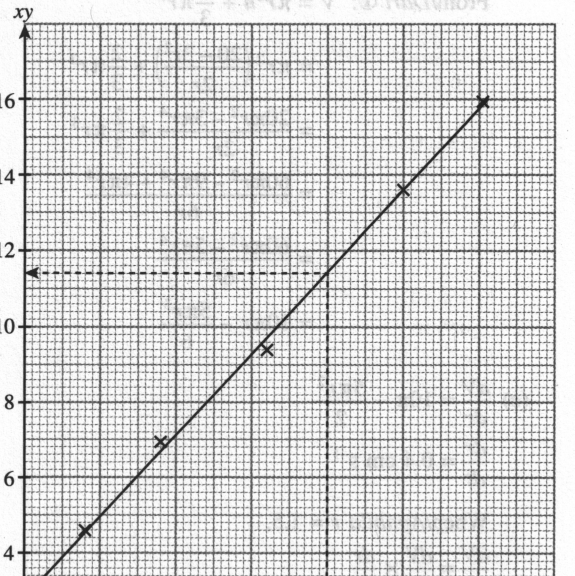
(i) $P(X \leqslant 81) + P(X \geqslant 108)$
$$= P\left(Z \leqslant \frac{81-90}{12}\right) + P\left(Z \geqslant \frac{108-90}{12}\right)$$
$$= P(Z \leqslant -0.75) + P(Z \geqslant 1.5)$$
$$= 0.2266 + 0.0668$$
$$= 0.2934$$

(ii) $P(X < h) = 0.05$
$$P\left(Z < \frac{h-90}{12}\right) = 0.05$$

From the normal distribution table:
Dari jadual taburan normal:
$P(Z < -1.645) = 0.05$
$$\therefore \quad \frac{h-90}{12} = -1.645$$
$$h - 90 = -19.74$$
$$h = 70.26$$

10 (a)

x^2	1	4	9	16	25	30.25
xy	3.10	4.60	6.99	9.40	13.60	15.90



(b) $y = 2mx + \dfrac{n}{5x}$

$xy = 2mx^2 + \dfrac{n}{5}$

$Y = mX + C$

(i) Gradient/*Kecerunan* $= 2m$

$2m = \dfrac{13.6 - 2.8}{25 - 0}$

$= 0.432$

$m = 0.216$

(ii) $C = \dfrac{n}{5} = 2.8$

$n = 2.8 \times 5$

$= 14$

(iii) When/*Apabila* $x = 4.5$, $x^2 = 20.25$.

From the graph/*Daripada graf*:

When/*Apabila* $x^2 = 20.25$,

$xy = 11.4$

$4.5y = 11.4$

$y = 2.53$

11 (a) $A = \pi r^2 + 2\pi rh + 2\pi r^2$

$= 3\pi r^2 + 2\pi rh$

$V = \pi r^2 h + \dfrac{2}{3}\pi r^3$ ...... ①

(b) $3\pi r^2 + 2\pi rh = 20\pi$

$3r^2 + 2rh = 20$

$2rh = 20 - 3r^2$

$h = \dfrac{20 - 3r^2}{2r}$

From/*Dari* ①: $V = \pi r^2 h + \dfrac{2}{3}\pi r^3$

$= \pi r^2\left(\dfrac{20 - 3r^2}{2r}\right) + \dfrac{2}{3}\pi r^3$

$= \dfrac{20\pi r^2 - 3\pi r^4}{2r} + \dfrac{2}{3}\pi r^3$

$= \dfrac{60\pi r^2 - 9\pi r^4 + 4\pi r^4}{6r}$

$= \dfrac{60\pi r^2 - 5\pi r^4}{6r}$

$= 10\pi r - \dfrac{5\pi r^3}{6}$

(c) $\dfrac{dV}{dr} = 10\pi - \dfrac{5\pi r^2}{2}$

$\dfrac{dr}{dt} = 0.4 \text{ cm s}^{-1}$

When/*Apabila* $r = 1.5$,

$\dfrac{dV}{dt} = \dfrac{dV}{dr} \times \dfrac{dr}{dt}$

$= \left[10\pi - \dfrac{5\pi(1.5)^2}{2}\right] \times 0.4$

$= 4.375\pi \times 0.4$

$= 1.75\pi \text{ cm}^3 \text{ s}^{-1}$

12 (a) $v = pt^2 - 5t$

$a = \dfrac{dv}{dt} = 2pt - 5$

When/*Apabila* $t = 2$, $a = 15$.

$2p(2) - 5 = 15$

$4p = 20$

$p = 5$

(b) $a < 0$

$10t - 5 < 0$

$10t < 5$

$t < \dfrac{1}{2}$

$\therefore$ Time interval/*Julat masa* : $0 \leqslant t < \dfrac{1}{2}$

(c) $v = 0$

$5t^2 - 5t = 0$

$5t(t - 1) = 0$

$5t = 0$ or/*atau* $t - 1 = 0$

$t = 0$ $\quad t = 1$

(d) Total distance travelled/*Jumlah jarak yang dilalui*

$= \left|\int_0^1 (5t^2 - 5t)\, dt\right| + \int_1^3 (5t^2 - 5t)\, dt$

$= \left|\left[\dfrac{5t^3}{3} - \dfrac{5t^2}{2}\right]_0^1\right| + \left[\dfrac{5t^3}{3} - \dfrac{5t^2}{2}\right]_1^3$

$= \left|\left(\dfrac{5}{3} - \dfrac{5}{2}\right) - 0\right| + \left[\dfrac{5(3)^3}{3} - \dfrac{5(3)^2}{2}\right] - \left(\dfrac{5}{3} - \dfrac{5}{2}\right)$

$= \left|-\dfrac{5}{6}\right| + \dfrac{45}{2} + \dfrac{5}{6}$

$= 24\dfrac{1}{6}$ m

13 (a) $\angle BAD = 180° - 78° - 32° = 70°$

$\dfrac{BD}{\sin 70°} = \dfrac{9}{\sin 32°}$

$BD = \dfrac{9 \sin 70°}{\sin 32°} = 15.96$ cm

(b) $15.96^2 = 11^2 + 8^2 - 2(11)(8) \cos \angle BCD$

$\cos \angle BCD = \dfrac{11^2 + 8^2 - 15.96^2}{2(11)(8)}$

$\angle BCD = 113.34°$

(c) Area of quadrilateral *ABCD*/*Luas sisi empat ABCD*

= Area of ΔABD + Area of ΔBCD

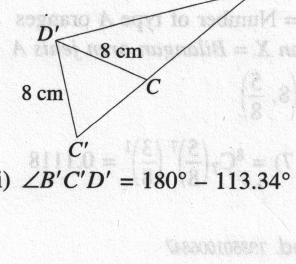
Luas ΔABD + *Luas* ΔBCD

$= \dfrac{1}{2}(15.96)(9) \sin 78° + \dfrac{1}{2}(8)(11) \sin 113.34°$

$= 70.25 + 40.40$

$= 110.65 \text{ cm}^2$

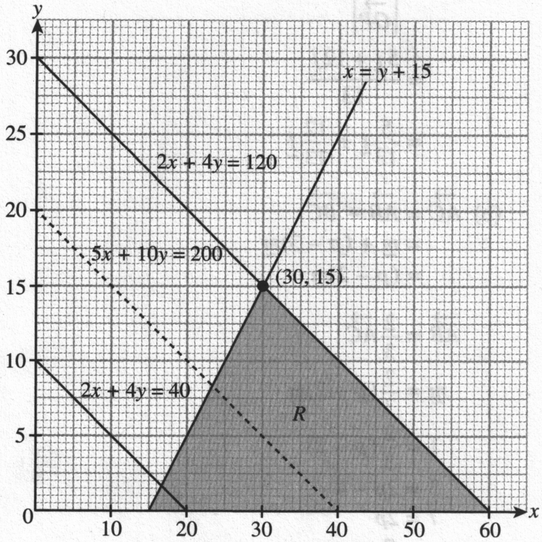
(d) (i)



(ii) $\angle B'C'D' = 180° - 113.34° = 66.66°$

14 (a) I : $x \geqslant y + 15$
II : $2x + 4y \geqslant 40$
III : $2x + 4y \leqslant 120$

(b)



(c) (i) Based on the graph/*Berdasarkan graf*, $x_{min} = 17$

(ii) Amount of sales/*Jumlah jualan*, $k = 5x + 10y$
Let/*Katakan*: $5x + 10y = 200$
Optimum point/*Titik optimum* = (30, 15)
Maximum sales/*Jualan maksimum*
= 5(30) + 10(15)
= RM300

15 (a) $\frac{w}{4.00} \times 100 = 120$

$w = \frac{120 \times 4.00}{100}$
$= 4.80$

(b) Price in 2015/*Harga pada* 2015 = RMx
Price in 2017/*Harga pada* 2017 = RMy

$y = x + 2$

$\frac{y}{x} \times 100 = 140$

$\frac{x+2}{x} \times 100 = 140$

$\frac{x+2}{x} = 1.4$

$x + 2 = 1.4x$
$0.4x = 2$
$x = 5$
$y = 7$

(c) $I_E = 120$

$I_F = \frac{3.50}{2.50} \times 100 = 140$

$I_G = 140$

$I_H = \frac{4.80}{4.00} \times 100 = 120$

Composite index/*Indeks gubahan*

$= \frac{120(7) + 140(3) + 140(4) + 120(3)}{7 + 3 + 4 + 2}$

$= \frac{2\,180}{16}$

$= 136.25$

(d) Composite index from the year 2015 to the year 2019
Indeks gubahan dari tahun 2015 *ke tahun* 2019
= 136.25 × 130%
= 177.13

Price of a bowl of dessert in the year 2019
Harga semangkuk pencuci mulut pada tahun 2019

$= \text{RM}15 \times \frac{177.13}{100}$

= RM26.57

KERTAS MODEL SPM 3

Kertas 1

1 (a) $f(x) = ax^2 + 1$, $gf(x) = 6x^2 + b$

$f(2) = 9$
$a(2^2) + 1 = 9$
$4a = 8$
$a = 2$

$gf(2) = 23$
$6(2^2) + b = 23$
$24 + b = 23$
$b = -1$

(b) $g[f(x)] = 6x^2 - 1$

Let/*Katakan* $y = f(x)$
$y = 2x^2 + 1$
$2x^2 = y - 1$
$x^2 = \frac{y-1}{2}$

$g(y) = 6\left(\frac{y-1}{2}\right) - 1$
$= 3(y - 1) - 1$
$= 3y - 4$

$\therefore g(x) = 3x - 4$

2 (a) $y = kx^4$
$\log_{10} y = \log_{10} k + \log_{10} x^4$
$\log_{10} y = 4 \log_{10} x + \log_{10} k$

(b) $y = -x^3 + 10x$
$\frac{y}{x} = -x^2 + 10$

$(h, 4)$: $4 = -h + 10$
$h = 6$

$(1, k)$: $k = -1 + 10$
$= 9$

3 (a) $2^x (8) = \left(\frac{1}{16}\right)^{2x+3}$

$2^x (2^3) = (2^{-4})^{2x+3}$
$2^{x+3} = 2^{-4(2x+3)}$

$$x + 3 = -4(2x + 3)$$
$$x + 3 = -8x - 12$$
$$9x = -15$$
$$x = -\frac{5}{3}$$

(b) $\log_4 (x + 6) - \log_4 x = 1$

$$\log_4 \left(\frac{x+6}{x}\right) = 1$$
$$\frac{x+6}{x} = 4^1$$
$$x + 6 = 4x$$
$$3x = 6$$
$$x = 2$$

4 (a) (i) $r = \frac{4}{-12} = -\frac{1}{3}$

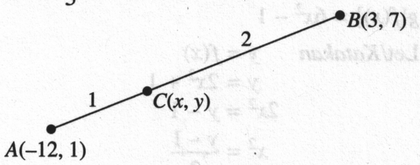
(ii) $S_\infty = \frac{a}{1-r} = \frac{-12}{1-\left(-\frac{1}{3}\right)} = -9$

(b) $S_9 = \frac{9}{2}[3(9) - 11] = 72$

$S_{10} = \frac{10}{2}[3(10) - 11] = 95$

$T_{10} = S_{10} - S_9$
$= 95 - 72$
$= 23$

5 (a) $AC = \frac{1}{3}AB \Rightarrow AC : BC = 1 : 2$



$x = \frac{2(-12) + 1(3)}{1 + 2} = \frac{-24 + 3}{3} = -7$

$y = \frac{2(1) + 1(7)}{1 + 2} = \frac{2 + 7}{3} = 3$

$\therefore C(-7, 3)$

(b) $\frac{1}{2}\begin{vmatrix} 1 & 5 & -3 & 1 \\ 3 & 2 & k & 3 \end{vmatrix} = 12$

$\frac{1}{2}\left|(2 + 5k - 9) - (15 - 6 + k)\right| = 12$

$\frac{1}{2}\left|4k - 16\right| = 12$

$| 4k - 16 | = 24$

$4k - 16 = 24$ or/*atau* $4k - 16 = -24$
$4k = 40$ $\quad$ $4k = -8$
$k = 10$ $\quad$ $k = -2$

6 (a) (i) $\overrightarrow{OP} = 5\underset{\sim}{i} + 12\underset{\sim}{j}$

(ii) $\left|\overrightarrow{OP}\right| = \sqrt{5^2 + 12^2}$
$= 13$ units

Unit vector in the direction of $\overrightarrow{OP}$
Vektor unit dalam arah $\overrightarrow{OP}$

$= \frac{\overrightarrow{OP}}{\left|\overrightarrow{OP}\right|}$

$= \frac{5\underset{\sim}{i} + 12\underset{\sim}{j}}{13}$

$= \frac{5}{13}\underset{\sim}{i} + \frac{12}{13}\underset{\sim}{j}$

(b) $\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$
$= \underset{\sim}{m} + (p - 3)\underset{\sim}{m}$
$= (p - 2)\underset{\sim}{m}$

$\overrightarrow{AB} = \frac{2}{3}\overrightarrow{AC}$

$\underset{\sim}{m} = \frac{2}{3}(p - 2)\underset{\sim}{m}$

$1 = \frac{2}{3}(p - 2)$

$3 = 2p - 4$

$7 = 2p$

$p = \frac{7}{2}$

7 (a) (i) $\tan A = -\frac{5}{12}$

(ii) $\sin (A - B) = \sin A \cos B - \cos A \sin B$

$= \left(\frac{5}{13}\right)\left(\frac{4}{5}\right) - \left(-\frac{12}{13}\right)\left(\frac{3}{5}\right)$

$= \frac{20}{65} + \frac{36}{65}$

$= \frac{56}{65}$

(b) $4 \cos 2x + \sin x = -3$
$4(1 - 2 \sin^2 x) + \sin x = -3$
$4 - 8 \sin^2 x + \sin x = -3$
$8 \sin^2 x - \sin x - 7 = 0$
$(8 \sin x + 7)(\sin x - 1) = 0$

$\sin x = -\frac{7}{8}$ or/*atau* $\sin x = 1$
$x = 241.04°, 298.96°$ $\quad$ $x = 90°$

$\therefore x = 90°, 241.04°, 298.96°$

8 (a) The locus of point P is a circle with centre $A(3, 2)$.
Lokus titik P ialah satu bulatan berpusat A(3, 2).

$$PA = 3$$
$$\sqrt{(x - 3)^2 + (y - 2)^2} = 3$$
$$x^2 - 6x + 9 + y^2 - 4y + 4 = 9$$
$$x^2 + y^2 - 6x - 4y + 4 = 0$$

(b) Sanusi's total incomes for 10 years
Jumlah pendapatan Sanusi untuk 10 tahun

$= \frac{\text{RM90 000}(1.2^{10} - 1)}{1.2 - 1}$

$=$ RM2 336 281.39

Jeff's total incomes for 10 years
Jumlah pendapatan Jeff untuk 10 tahun
= 10 × RM200 000
= RM2 000 000

Difference between their total incomes
Beza antara jumlah pendapatan mereka
= RM2 336 281.39 – RM2 000 000
= RM336 281.39

9 (a) (i) $m(x) = \frac{4-x}{3}$

$mn(x) = 1 + \frac{x}{3}$

$m[n(x)] = 1 + \frac{x}{3}$

$\frac{4-n(x)}{3} = 1 + \frac{x}{3}$

$4 - n(x) = 3 + x$

$n(x) = 1 - x$

(ii) $m(x) = n(x)$

$\frac{4-x}{3} = 1 - x$

$4 - x = 3 - 3x$

$2x = -1$

$x = -\frac{1}{2}$

(b) $b^2 - 4ac < 0$

$(-3k)^2 - 4(2k + 1)(2k - 4) < 0$

$9k^2 - 4(4k^2 - 6k - 4) < 0$

$-7k^2 + 24k + 16 < 0$

$7k^2 - 24k - 16 > 0$

$(7k + 4)(k - 4) > 0$

$k < -\frac{4}{7}$ or/*atau* $k > 4$

10 (a) $y = 2x(x - 6)$

$= 2x^2 - 12x$

$\frac{dy}{dx} = 4x - 12$

When/*Apabila* $x = 1$, $\frac{dy}{dx} = 4(1) - 12 = -8$

The value of y is minimum when $\frac{dy}{dx} = 0$.

Nilai y adalah minimum apabila $\frac{dy}{dx} = 0$.

$\frac{dy}{dx} = 4x - 12 = 0$

$4x = 12$

$x = 3$

(b) $\int \frac{8}{(3-2x)^3}\,dx = \int 8(3 - 2x)^{-3}\,dx$

$= \frac{8(3-2x)^{-3+1}}{-2(-2)} + c$

$= 2(3 - 2x)^{-2} + c$

$\therefore k = 2, n = -2$

11 (a) (i) ${}^6C_4 \times {}^7C_5 = 15 \times 21$

$= 315$

(ii) ${}^5P_5 \times {}^5P_5 = 120 \times 120$

$= 14\,400$

(b) ${}^6P_4 \times {}^3P_1 = 360 \times 3$

$= 1\,080$

12 (a) $X \sim B(10, 0.35)$

(i) $P(X = 6) = {}^{10}C_6\,(0.35)^6\,(0.65)^4$

$= 0.0689$

(ii) $P(X \leq 7)$

$= 1 - P(X > 7)$

$= 1 - P(X = 8) - P(X = 9) - P(X = 10)$

$= 1 - {}^{10}C_8\,(0.35)^8\,(0.65)^2 - {}^{10}C_9\,(0.35)^9(0.65)^1 - {}^{10}C_{10}\,(0.35)^{10}\,(0.65)^0$

$= 1 - 0.00428 - 0.00051 - 0.00003$

$= 0.9952$

(b) (i) $0.2 + m + 0.1 + 0.3 = 1$

$m + 0.6 = 1$

$m = 0.4$

(ii) $P(X \geq 1) = 0.4 + 0.1 + 0.3$

$= 0.8$

13 (a) Arc length/*Panjang lengkok*: $r\theta = 8$

Area of sector/*Luas sektor*:

$\frac{1}{2}r^2\theta = 48$

$\frac{1}{2}r(r\theta) = 48$

$\frac{1}{2}r(8) = 48$

$r = 12$

Diameter = 2 × 12 = 24 cm

(b) (i) Arithmetic progression/*Janjang aritmetik*:

$a = 61$, $d = 1.2$

$T_6 = a + 5d$

$= 61 + 5(1.2)$

= 67 seconds/*saat*

(ii) 10 000 ÷ 400 = 25 laps/*pusingan*

$S_{25} = \frac{25}{2}(2a + 24d)$

$= \frac{25}{2}[2(61) + 24(1.2)]$

$= \frac{25}{2}(150.8)$

= 1 885 seconds/*saat*

(iii) $S_{17} = \frac{17}{2}(2a + 16d)$

$= \frac{17}{2}[2(61) + 16(1.2)]$

= 1 200.2 seconds/*saat*

$S_{25} - S_{17} = 1\,885 - 1\,200.2$

= 684.8 seconds/*saat*

14 (a) Area of playground:
Luas taman permainan:

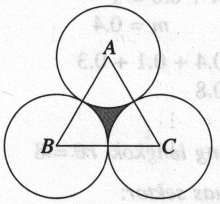
$y(x - 10) + 30(10) = 460$
$xy - 10y + 300 = 460$
$xy - 10y = 160 \quad ...... ①$

Perimeter of fish pond:
Perimeter kolam ikan:
$2(x - 10) + 2(30 - y) = 48$
$x - 10 + 30 - y = 24$
$x - y + 20 = 24$
$x = y + 4$

From/*Dari* ①: $(y + 4)y - 10y = 160$
$y^2 + 4y - 10y = 160$
$y^2 - 6y - 160 = 0$
$(y - 16)(y + 10) = 0$
$y = 16$ or/*atau* $y = -10$
(Ignore/*Abaikan*)

$\therefore y = 16$ m
$x = 16 + 4 = 20$ m

(b)



ABC is an equilateral triangle.
ABC ialah segi tiga sama sisi.

$60° = 60 \times \frac{3.142}{180} = 1.04733$ rad

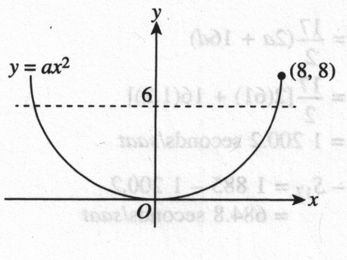
(i) Perimeter of the shaded region
Perimeter kawasan berlorek
$= 3 \times 6(1.04733)$
$= 3 \times 6.2840$
$= 18.852$ cm

(ii) Area of the shaded region
Luas kawasan berlorek
$= \left[\frac{1}{2}(12^2) \sin 60°\right] - 3\left[\frac{1}{2}(6^2) \times 1.04733\right]$
$= 62.3538 - 56.5558$
$= 5.798 \text{ cm}^2$

15 (a) $g(x) = x^2 - 18x + k$
$= x^2 - 18x + (-9)^2 - (-9)^2 + k$
$= (x - 9)^2 - 81 + k$

$-81 + k > 10$
$k > 91$

(b)



(i) $y = ax^2$
(8, 8): $8 = a(8^2)$
$a = \frac{1}{8}$

(ii) Volume of porridge
Isi padu bubur
$= \int_0^6 \pi x^2 \, dy$
$= \int_0^6 \pi (8y) \, dy$
$= \pi \left[4y^2\right]_0^6$
$= 4\pi(36 - 0)$
$= 144\pi \text{ cm}^2$

Kertas 2

1 (a) For the top most layer of cake:
Untuk lapisan kek yang paling atas:

Circumference/*lilitan*, $2\pi r_1 = 20$
$r_1 = 10$ cm

For the bottom most layer of cake:
Untuk lapisan kek bawah sekali:

Volume/*Isi padu*, $\pi r^2 h = 14\,112\pi$
$8r^2 = 14\,112$
$r^2 = 1\,764$
$r = 42$ cm

Radius/*Jejari*: 10, 14, 18, ..., 42

$T_n = 10 + 4(n - 1) = 42$
$4(n - 1) = 32$
$n - 1 = 8$
$n = 9$

Thus, the whole wedding cake has 9 layers.
Maka, seluruh kek perkahwinan itu mempunyai 9 lapisan.

Height of whole cake
Tinggi seluruh kek
$= 9 \times 8$ cm
$= 72$ cm

(b) Radius/*Jejari*: 10, 14, 18, ..., 42
Circumference/*Lilitan*:
$20\pi, 2\pi(14), 2\pi(18), ..., 2\pi(42)$
$= 20\pi, 28\pi, 36\pi, ..., 84\pi$

$S_n = \frac{n}{2}(a + \ell)$

$S_9 = \frac{9}{2}(20\pi + 84\pi)$
$= \frac{9}{2}(104\pi)$
$= 468\pi$ cm

Total length of the ribbon needed is 468π cm.
Jumlah panjang reben yang diperlukan ialah 468π cm.

2 (a) Area of the shaded region
Luas rantau berlorek

$= \int_0^2 (x^2 + 3)\,dx + \frac{1}{2}\left(\frac{20}{3} - 2\right)(7)$

$= \left[\frac{x^3}{3} + 3x\right]_0^2 + \frac{49}{3}$

$= \left[\frac{2^3}{3} + 3(2) - 0\right] + \frac{49}{3}$

$= 25 \text{ unit}^2$

(b) Volume generated/*Isi padu janaan*

$= \int_3^7 \pi x^2\,dy$

$= \pi\int_3^7 (y - 3)\,dy$

$= \pi\left[\frac{y^2}{2} - 3y\right]_3^7$

$= \pi\left[\left(\frac{7^2}{2} - 3(7)\right) - \left(\frac{3^2}{2} - 3(3)\right)\right]$

$= \pi\left(\frac{7}{2} + \frac{9}{2}\right)$

$= 8\pi \text{ unit}^3$

3 (a) Volume of the box/*Isi padu kotak*,

$V = x(30 - 2x)(16 - 2x)$
$= x(480 - 60x - 32x + 4x^2)$
$= x(4x^2 - 92x + 480)$
$= 4x^3 - 92x^2 + 480x$

$\frac{dV}{dx} = 12x^2 - 184x + 480$

When/*Apabila* $\frac{dV}{dx} = 0$,

$12x^2 - 184x + 480 = 0$
$3x^2 - 46x + 120 = 0$
$(3x - 10)(x - 12) = 0$

$x = \frac{10}{3}$ or/*atau* $x = 12$

The length of sides of the squares is $3\frac{1}{3}$ cm.

Panjang tepi segi empat sama ialah $3\frac{1}{3}$ cm.

(b) Volume of a box/*Isi padu sebuah kotak*

$= \frac{10}{3}\left(30 - \frac{20}{3}\right)\left(16 - \frac{20}{3}\right)$

$= 725.93 \text{ cm}^3$

$\frac{5\,645}{725.93} = 7.78$

$\therefore$ 8 boxes are needed.
8 *buah kotak diperlukan.*

4 $4x + 3y - 8 = 0$

$3y = 8 - 4x$

$y = \frac{8 - 4x}{3}$ …… ①

$x^2 - xy - 8 = 0$ …… ②

Substitute ① into ②.
Gantikan ① ke dalam ②.

$x^2 - xy - 8 = 0$

$x^2 - x\left(\frac{8 - 4x}{3}\right) - 8 = 0$

$3x^2 - 8x + 4x^2 - 24 = 0$

$7x^2 - 8x - 24 = 0$

$x = \frac{8 \pm \sqrt{(-8)^2 - 4(7)(-24)}}{2(7)}$

$= \frac{8 \pm \sqrt{736}}{14}$

$= 2.509$ or/*atau* -1.366

Substitute the values of x into ①.
Gantikan nilai-nilai x ke dalam ①.

When/*Apabila* $x = 2.509$, $y = \frac{8 - 4(2.509)}{3}$
$= -0.6787$

When/*Apabila* $x = -1.366$, $y = \frac{8 - 4(-1.366)}{3}$
$= 4.488$

$\therefore x = 2.509, y = -0.679$ and/*dan* $x = -1.366, y = 4.488$

5 (a) (i) $f(-1) = -11$

$h(-1) + k = -11$

$-h + k = -11$ …… ①

$f(2) = 7$

$h(2) + k = 7$

$2h + k = 7$ …… ②

② – ①: $3h = 18$

$h = 6$

From/*Dari* ①: $-6 + k = -11$

$k = -5$

(ii) $f(x) = 6x - 5$

$f(-1) = 6(-1) - 5$

$= -11$

(b) Area of the shaded region/*Luas kawasan berlorek*
= Area of *PQRS* – Area of *ABCS*
Luas PQRS – Luas ABCS
$= 3x(x + 2) - (x - 1)(x + 4)$

$\therefore 3x(x + 2) - (x - 1)(x + 4) = 69$

$3x^2 + 6x - (x^2 + 3x - 4) = 69$

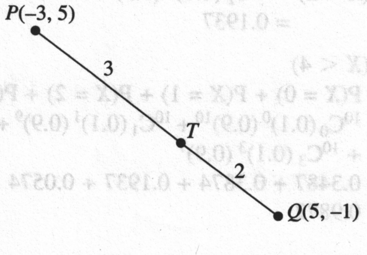
$2x^2 + 3x - 65 = 0$

6 (a) Area of/*Luas* $\Delta POQ = \frac{1}{2}\begin{vmatrix} -3 & 0 & 5 & -3 \\ 5 & 0 & -1 & 5 \end{vmatrix}$

$= \frac{1}{2}\left|25 - 3\right|$

$= 11 \text{ unit}^2$

(b)



Coordinates of point *T*/*Koordinat titik T*

$= \left(\dfrac{3(5) + 2(-3)}{3 + 2}, \dfrac{3(-1) + 2(5)}{3 + 2}\right)$

$= \left(\dfrac{9}{5}, \dfrac{7}{5}\right)$

(c) $AP = 2AQ$

$\sqrt{(x + 3)^2 + (y - 5)^2} = 2\sqrt{(x - 5)^2 + (y + 1)^2}$

$x^2 + 6x + 9 + y^2 - 10y + 25 = 4(x^2 - 10x + 25 + y^2 + 2y + 1)$

$x^2 + 6x + 9 + y^2 - 10y + 25 = 4x^2 - 40x + 100 + 4y^2 + 8y + 4$

$3x^2 + 3y^2 - 46x + 18y + 70 = 0$

7 (a) $AM \times 1.36 = 15$

$AM = 11.03$ cm

$JM = KN = 11.03 - 8$

$= 3.03$ cm

Perimeter of the shaded region
Perimeter kawasan berlorek

$= 2(3.03) + 12 + 15$

$= 33.06$ cm

(b) Area of sector *AMN*
Luas sektor AMN

$= \dfrac{1}{2}(11.03)^2 (1.36)$

$= 82.729 \text{ cm}^2$

$\dfrac{5}{OJ} = \sin 1.36$

$OJ = 5.113$ cm

Area of segment *JK*
Luas tembereng JK

$= \dfrac{1}{2}(5.113)^2 (2.72 - \sin 2.72)$

$= 30.205 \text{ cm}^2$

Area of triangle *AJK*
Luas segi tiga AJK

$= \dfrac{1}{2}(8)(8) \sin 1.36$

$= 31.292 \text{ cm}^2$

Area of the shaded region
Luas kawasan berlorek

$= 82.729 - 30.205 - 31.292$

$= 21.232 \text{ cm}^2$

8 (a) Let X = Number of cats that have yellow fur
Katakan X = Bilangan kucing yang berbulu kuning
$X \sim B(10, 0.1)$

(i) $P(X = 2) = {}^{10}C_2 (0.1)^2 (0.9)^8$

$= 0.1937$

(ii) $P(X < 4)$

$= P(X = 0) + P(X = 1) + P(X = 2) + P(X = 3)$

$= {}^{10}C_0 (0.1)^0 (0.9)^{10} + {}^{10}C_1 (0.1)^1 (0.9)^9 + 0.1937 + {}^{10}C_3 (0.1)^3 (0.9)^7$

$= 0.3487 + 0.3874 + 0.1937 + 0.0574$

$= 0.9872$

(b) $X \sim N(43, 10^2)$

(i) $P(X \leqslant 55.9) = P\left(Z \leqslant \dfrac{55.9 - 43}{10}\right)$

$= P(Z < 1.29)$

$= 1 - P(Z > 1.29)$

$= 1 - 0.0985$

$= 0.9015$

(ii) $P(X > m) = 0.6$

$P(X < m) = 0.4$

$P\left(Z < \dfrac{m - 43}{10}\right) = 0.4$

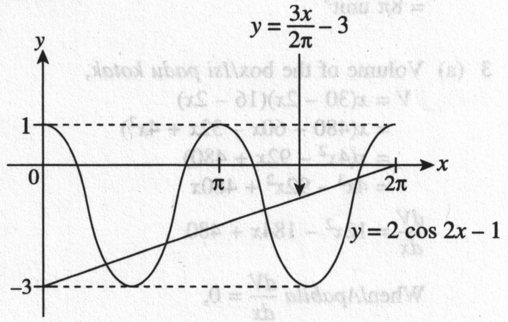
From the normal distribution table:
Dari jadual taburan normal:
$P(Z < -0.253) = 0.4$

$\therefore \dfrac{m - 43}{10} = -0.253$

$m - 43 = -2.53$

$m = 40.47$

9 (a) (i), (ii)



$2 \cos 2x + 2 = \dfrac{3x}{2\pi}$

$2 \cos 2x + 2 - 3 = \dfrac{3x}{2\pi} - 3$

$2 \cos 2x - 1 = \dfrac{3x}{2\pi} - 3$

The suitable straight line to be drawn is:
Garis lurus yang sesuai dilukis ialah:

$y = \dfrac{3x}{2\pi} - 3$

When/*Apabila* $x = 0, y = -3$.

When/*Apabila* $x = \pi, y = \dfrac{3}{2}$.

Number of solutions/*Bilangan penyelesaian* = 4

(b) $2 \cos (x + 45°) \cos (x - 45°)$

$= 2(\cos x \cos 45° - \sin x \sin 45°)(\cos x \cos 45° + \sin x \sin 45°)$

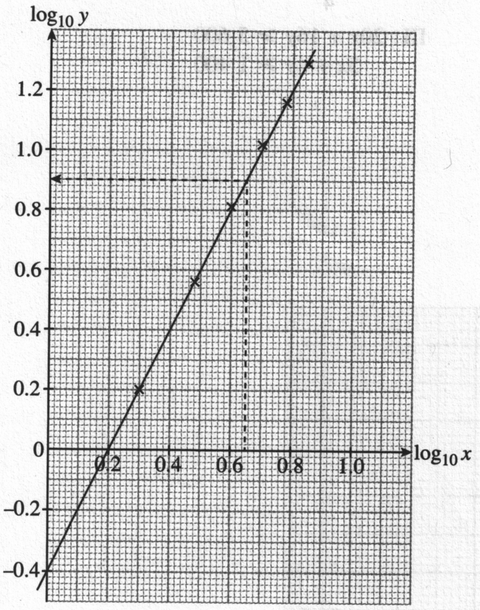
$= 2\left(\dfrac{1}{\sqrt{2}}\right)\left(\dfrac{1}{\sqrt{2}}\right) (\cos x - \sin x)(\cos x + \sin x)$

$= \cos^2 x - \sin^2 x$

$= \cos 2x$

10 (a)

$\log_{10} x$	0.30	0.48	0.60	0.70	0.78	0.85
$\log_{10} y$	0.20	0.56	0.81	1.02	1.16	1.29



(b) (i) $y = hx^{k+1}$

$\log_{10} y = \log_{10} h + \log_{10} x^{k+1}$

$\log_{10} y = (k+1)\log_{10} x + \log_{10} h$

$Y \quad = \quad mX \quad + \quad C$

$C = \log_{10} h = -0.4$

$h = 0.3981$

$m = k + 1 = \dfrac{1.16 - (-0.4)}{0.78 - 0}$

$k + 1 = 2$

$k = 1$

(ii) When/*Apabila* $x = 4.5$, $\log_{10} x = 0.6532$

From the graph/*Daripada graf*:

When/*Apabila* $\log_{10} x = 0.65$,

$\log_{10} y = 0.90$

$y = 7.943$

11 (a) (i) $\overrightarrow{OS} = \overrightarrow{OP} + \overrightarrow{PS}$

$= 8\underset{\sim}{x} + 4\underset{\sim}{y}$

(ii) $\overrightarrow{PQ} = \overrightarrow{PO} + \overrightarrow{OQ}$

$= -8\underset{\sim}{x} + 10\underset{\sim}{y}$

(b) (i) $\overrightarrow{OT} = h\overrightarrow{OS}$

$= h(8\underset{\sim}{x} + 4\underset{\sim}{y})$

$= 8h\underset{\sim}{x} + 4h\underset{\sim}{y}$ …… ①

(ii) $\overrightarrow{PT} = k\overrightarrow{PQ}$

$\overrightarrow{OT} - \overrightarrow{OP} = k\overrightarrow{PQ}$

$\overrightarrow{OT} = k\overrightarrow{PQ} + \overrightarrow{OP}$

$= k(-8\underset{\sim}{x} + 10\underset{\sim}{y}) + 8\underset{\sim}{x}$

$= (8 - 8k)\underset{\sim}{x} + 10k\underset{\sim}{y}$ …… ②

(c) Compare ① and ②/*Bandingkan ① dan ②.*

$4h = 10k$

$8 - 8k = 8h$

$8 - 8k = 20k$

$8 = 28k$

$k = \dfrac{2}{7}$

$4h = 10\left(\dfrac{2}{7}\right)$

$h = \dfrac{5}{7}$

$OT = \dfrac{5}{7}\,OS$

$OT : TS = 5 : 2$

12 (a) (i) $8^2 = 5^2 + AC^2 - 2(5)(AC)\cos 60°$

$64 = 25 + AC^2 - 5AC$

$AC^2 - 5AC - 39 = 0$

$AC = \dfrac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(-39)}}{2(1)}$

$= 9.227$ or/*atau* -4.227

Since/*Oleh sebab* $AC > 0$, $AC = 9.227$ cm.

$AE = AC - CE$

$= 9.227 - 8.5$

$= 0.727$ cm

(ii) $\dfrac{1}{2}(8.5)(15.6)\sin \angle CED = 54$

$\sin \angle CED = \dfrac{2(54)}{8.5(15.6)}$

$\angle CED = 125.46°$

(b) (i) $\tan \angle AED = \dfrac{7}{10}$

$\angle AED = 34.99°$

(ii) $AE = AF = \sqrt{10^2 + 7^2} = \sqrt{149}$ cm

$8^2 = (\sqrt{149})^2 + (\sqrt{149})^2 - 2(\sqrt{149})(\sqrt{149})\cos \angle FAE$

$64 = 149 + 149 - 2(149)\cos \angle FAE$

$\cos \angle FAE = \dfrac{149 + 149 - 64}{2(149)}$

$\angle FAE = 38.26°$

13 (a) $\dfrac{\text{RM50}}{Q_{2020}} \times 100 = 125$

$Q_{2020} = \dfrac{\text{RM50} \times 100}{125}$

$= \text{RM40}$

(b) $\dfrac{125(4) + 120p + 80(5) + 150(p+3)}{4 + p + 5 + (p+3)} = 120$

$\dfrac{500 + 120p + 400 + 150p + 450}{12 + 2p} = 120$

$1\,350 + 270p = 1\,440 + 240p$

$30p = 90$

$p = 3$

(c) $\dfrac{P_{2021}}{RM15} \times 100 = 120$

$P_{2021} = \dfrac{120 \times RM15}{100}$

$= RM18$

(d) $I_C = 80 \times \dfrac{115}{100} = 92$

$\bar{I} = \dfrac{125(4) + 120(3) + 80(5) + 150(6)}{12 + 6}$

$= \dfrac{2\,220}{18}$

$= 123.33$

14 (a) I : $x + y \leqslant 360$

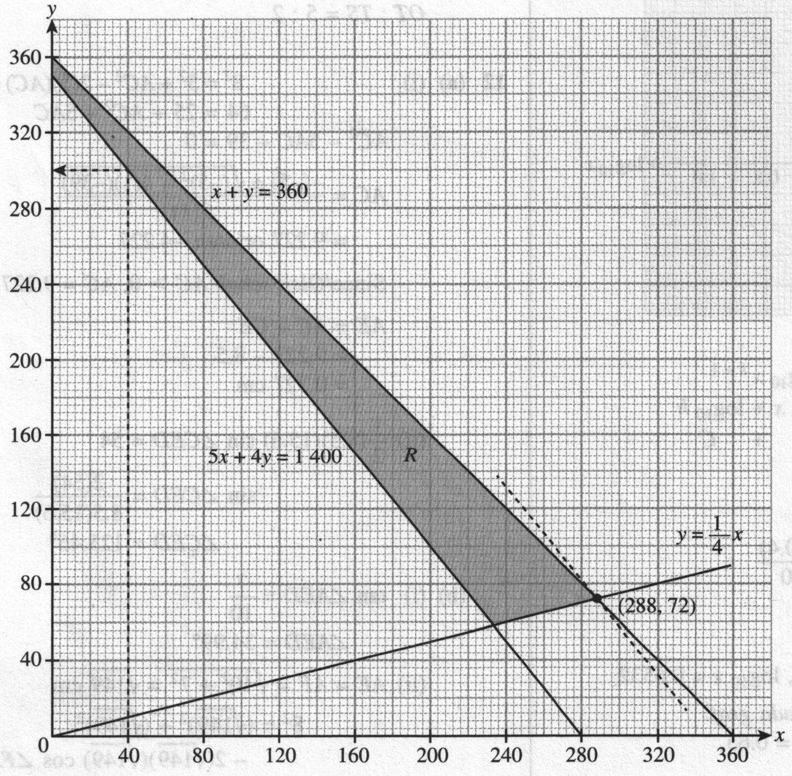
II : $x \leqslant 4y$

$y \geqslant \dfrac{1}{4}x$

III: $20x + 16y \geqslant 5\,600$

$5x + 4y \geqslant 1\,400$

(b)



(c) (i) When $x = 40$, the minimum value of y is 300.
Apabila $x = 40$, nilai minimum y ialah 300.

The minimum number of toy B produced is 300 units.
Bilangan minimum alat mainan B yang dihasilkan ialah 300 *unit.*

(ii) Total profits/*Jumlah keuntungan* $= 20x + 16y$
Optimum point/*Titik optimum* = (288, 72)

Maximum total profits
Jumlah keuntungan maksimum
$= 20(288) + 16(72)$
$=$ RM6 912

15 (a) $V_H = 20t - 5t^2 + 25$

$\dfrac{dV_H}{dt} = 20 - 10t$

When/*Apabila* $\dfrac{dV_H}{dt} = 0$, $20 - 10t = 0$

$10t = 20$

$t = 2$

$V_H = 20(2) - 5(2^2) + 25$

$= 45 \text{ cm s}^{-1}$

(b) $20t - 5t^2 + 25 = 0$

$5t^2 - 20t - 25 = 0$

$t^2 - 4t - 5 = 0$

$(t + 1)(t - 5) = 0$

$\therefore t = 5$

$V_H = 20t - 5t^2 + 25$

$S_H = \int (20t - 5t^2 + 25)\, dt$

$= 10t^2 - \dfrac{5}{3}t^3 + 25t + c$

When/*Apabila* $t = 0$, $S_H = 0$. $\therefore c = 0$.

$S_H = 10t^2 - \frac{5}{3}t^3 + 25t$

When/*Apabila* $t = 5$,

$S_H = 10(5^2) - \frac{5}{3}(5^3) + 25(5) = 166\frac{2}{3}$ cm

(c) $V_R = -20$

$S_R = -20t$

When/*Apabila* $t = 5$, $S_R = -20(5) = -100$ cm

Distance between car H and car R

Jarak di antara kereta H dan kereta R

$= 300 - 166\frac{2}{3} - 100$

$= 33\frac{1}{3}$ cm

KERTAS MODEL SPM 4

Kertas 1

1 (a) (i) $f(x) = 3x + 2$

$f(2) = 3(2) + 2$

$= 8$

(ii) $f(x) = 5$

$3x + 2 = 5$

$3x = 3$

$x = 1$

(b) $h(x) = ax + b$

$h[h(x)] = a(ax + b) + b$

$= a^2x + ab + b$

Given/*Diberi* $h^2(x) = 9x - 16$.

$\therefore a^2 = 9$ and/*dan* $ab + b = -16$

$a = 3\ (a > 0)$ $\quad 3b + b = -16$

$4b = -16$

$b = -4$

2 $f(x) = 8 - 2(x - 4)^2$

The maximum point is (4, 8).

Titik maksimum ialah (4, 8).

When/*Apabila* $f(x) = 0$,

$8 - 2(x - 4)^2 = 0$

$2(x - 4)^2 = 8$

$(x - 4)^2 = 4$

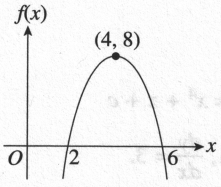
$x - 4 = \pm 2$

$x - 4 = 2$ or/*atau* $x - 4 = -2$

$x = 6$ $\qquad x = 2$

The x-intercepts are $x = 2$ and $x = 6$.

Pintasan-x ialah $x = 2$ *dan* $x = 6$.



The range of values of x is $2 \leqslant x \leqslant 6$.

Julat nilai x ialah $2 \leqslant x \leqslant 6$.

3 (a) (i) $\tan 2\beta = \frac{2 \tan \beta}{1 - \tan^2\beta}$

$= \frac{2\left(\frac{1}{3}\right)}{1 - \left(\frac{1}{3}\right)^2}$

$= \frac{3}{4}$

(ii) $\tan (90° - \beta) = \cot \beta$

$= \frac{1}{\tan \beta}$

$= 3$

(b) $2 \sec^2 x = 3 - \tan x$

$2(1 + \tan^2 x) = 3 - \tan x$

$2 + 2 \tan^2 x = 3 - \tan x$

$2 \tan^2 x + \tan x - 1 = 0$

$(2 \tan x - 1)(\tan x + 1) = 0$

$\tan x = \frac{1}{2}$ or/*atau* $\tan x = -1$

$x = 26.57°, 206.57°$ $\qquad x = 135°, 315°$

$\therefore x = 26.57°, 135°, 206.57°, 315°$

4 (a) $T_9 = a + 8d = 10$

$a + 8\left(\frac{1}{4}\right) = 10$

$a + 2 = 10$

$a = 8$

(b) $T_{11} = S_n$

$a + 10d = \frac{a(1 - r^n)}{1 - r}$

$8 + 10\left(\frac{1}{4}\right) = \frac{8\left[1 - \left(\frac{1}{4}\right)^n\right]}{1 - \frac{1}{4}}$

$\frac{21}{2} = \frac{32}{3}\left[1 - \left(\frac{1}{4}\right)^n\right]$

$\frac{63}{64} = 1 - \left(\frac{1}{4}\right)^n$

$\left(\frac{1}{4}\right)^n = \frac{1}{64}$

$\left(\frac{1}{4}\right)^n = \left(\frac{1}{4}\right)^3$

$n = 3$

5 (a) $y = \frac{1}{px^2 + q}$

$\frac{1}{y} = px^2 + q$

(1, 5): $5 = p(1) + q$

$5 = p + q$ ...... ①

(3, 9): $9 = p(3) + q$

$9 = 3p + q$ ...... ②

② − ①: $4 = 2p$

$p = 2$

$5 = 2 + q$

$q = 3$

(b) $\frac{1}{y} = 2x^2 + 3$

$\frac{1}{y} = 2(4) + 3 = 11$

Since $11 \neq 10$, the point (4, 10) does not lie on the straight line.
Oleh sebab $11 \neq 10$, *titik* (4, 10) *tidak berada di atas garis lurus itu.*

6 $4x + y + 8 = 2$

$y = -6 - 4x$ ...... ①

$x^2 + x - y = 2$ ...... ②

Substitute ① into ②.
Gantikan ① ke dalam ②.

$x^2 + x - (-6 - 4x) = 2$
$x^2 + x + 6 + 4x - 2 = 0$
$x^2 + 5x + 4 = 0$
$(x + 4)(x + 1) = 0$
$x = -4$ or/*atau* $x = -1$

Substitute the values of x into ①.
Gantikan nilai-nilai x ke dalam ①.

When/*Apabila* $x = -1$, $y = -6 - 4(-1) = -2$

When/*Apabila* $x = -4$, $y = -6 - 4(-4) = 10$

$\therefore x = -1, y = -2$ and/*dan* $x = -4, y = 10$.

7. (a) ${}^6P_4 = 360$

(b) Mixture of 2 flavours/*Campuran 2 perisa* $= {}^4C_2$
Mixture of 3 flavours/*Campuran 3 perisa* $= {}^4C_3$
Mixture of 4 flavours/*Campuran 4 perisa* $= {}^4C_4$

Total number of mixed flavours
Jumlah bilangan campuran perisa
$= {}^4C_2 + {}^4C_3 + {}^4C_4$
$= 6 + 4 + 1$
$= 11$

8 (a) Given/*Diberi* $AD : AB = 3 : 5$.
$\therefore AD : AC = 3 : 5$

$AC = 10$ cm $\Rightarrow$ $AD = 6$ cm

$\cos \theta = \frac{6}{10}$

$\theta = 0.9273$ rad

(b) Area of the shaded region
Luas kawasan berlorek
= Area of sector ABC – Area of ΔACD
Luas sektor ABC – Luas ΔACD
$= \frac{1}{2}(10^2)(0.9273) - \frac{1}{2}(6)(8)$
$= 46.365 - 24$
$= 22.365$ cm^2

9 (a) $4y + x = k$ ...... ①

$4y = -x + k$

$y = -\frac{1}{4}x + \frac{k}{4}$

The gradient of the normal line is $-\frac{1}{4}$.
Kecerunan garis normal ialah $-\frac{1}{4}$.

$m_T\left(-\frac{1}{4}\right) = -1$

$m_T = 4$

The gradient of the tangent line is 4.
Kecerunan garis tangen ialah 4.

$y = (2x - 1)^2 - 3$ ...... ②

$\frac{dy}{dx} = 2(2x - 1)^1(2) = 4$

$4(2x - 1) = 4$
$2x - 1 = 1$
$2x = 2$
$x = 1$

Substitute $x = 1$ into ②.
Gantikan x = 1 ke dalam ②.

$y = [2(1) - 1]^2 - 3 = -2$

$\therefore A(1, -2)$

Substitute $A(1, -2)$ into ①.
Gantikan A(1, –2) ke dalam ①.

$4(-2) + 1 = k$
$k = -7$

(b) Equation of the tangent to the curve at point A
Persamaan tangen kepada lengkung pada titik A

$y - (-2) = 4(x - 1)$
$y + 2 = 4x - 4$
$y = 4x - 6$

10 (a) $\frac{dy}{dx} = 2g(x)$

$g(x) = \frac{1}{2}\left(\frac{dy}{dx}\right)$

$\int_1^2 g(x)\, dx = \frac{1}{2}\Big[\, y \,\Big]_1^2$

$= \frac{1}{2}\left[\frac{2x - 1}{x^2}\right]_1^2$

$= \frac{1}{2}\left(\frac{2(2) - 1}{2^2} - \frac{2(1) - 1}{1^2}\right)$

$= \frac{1}{2}\left(\frac{3}{4} - 1\right)$

$= -\frac{1}{8}$

(b) $\frac{d^2y}{dx^2} = 4x^3 + 1$

$\frac{dy}{dx} = \int(4x^3 + 1)\, dx = x^4 + x + c$

When/*Apabila* $x = -1$, $\frac{dy}{dx} = 3$.

$(-1)^4 + (-1) + c = 3$
$c = 3$

$$\frac{dy}{dx} = x^4 + x + 3$$

$$y = \int (x^4 + x + 3)\, dx = \frac{x^5}{5} + \frac{x^2}{2} + 3x + d$$

When/*Apabila* $x = -1$, $y = \frac{1}{2}$.

$$\frac{(-1)^5}{5} + \frac{(-1)^2}{2} + 3(-1) + d = \frac{1}{2}$$

$$-\frac{1}{5} + \frac{1}{2} - 3 + d = \frac{1}{2}$$

$$d = \frac{16}{5}$$

$$\therefore\ y = \frac{x^5}{5} + \frac{x^2}{2} + 3x + \frac{16}{5}$$

11 (a) $X \sim B(n, p)$

$n = 4$

$$k = 1 - \left(\frac{16}{81} + \frac{7}{27} + \frac{16}{81} + \frac{1}{81}\right) = \frac{1}{3}$$

$$P(X = 4) = {}^4C_4 p^4 q^0 = \frac{1}{81}$$

$$p^4 = \frac{1}{81}$$

$$p^4 = \left(\frac{1}{3}\right)^4$$

$$p = \frac{1}{3}$$

(b) (i) $X \sim N(12.45, 9)$

$$\frac{X - 12.45}{3} = 1.35$$

$$X - 12.45 = 4.05$$

$$X = 16.5$$

(ii) $P(-k < Z < k) = 0.7881$

$$P(Z > k) = \frac{1 - 0.7881}{2}$$

$$= 0.106$$

$$k = 1.248$$

12 (a) $2p\underset{\sim}{x} + 3\underset{\sim}{y} = 2p(2\underset{\sim}{i} - \underset{\sim}{j}) + 3(-\underset{\sim}{i} + 3\underset{\sim}{j})$

$= 4p\underset{\sim}{i} - 2p\underset{\sim}{j} - 3\underset{\sim}{i} + 9\underset{\sim}{j}$

$= (4p - 3)\underset{\sim}{i} + (-2p + 9)\underset{\sim}{j}$

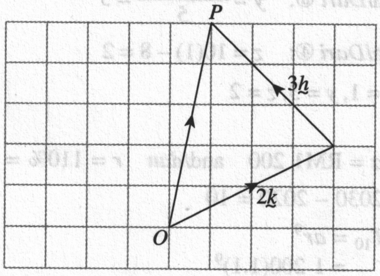
Parallel to the y-axis means the coefficient of $\underset{\sim}{i}$ is zero.

Selari dengan paksi-y bermaksud pekali $\underset{\sim}{i}$ ialah sifar.

$\therefore\ 4p - 3 = 0$

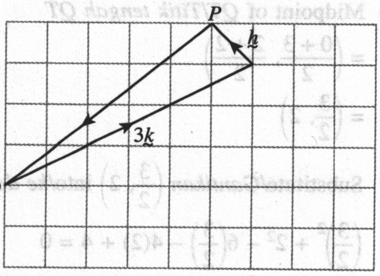
$$p = \frac{3}{4}$$

(b) (i)



$\overrightarrow{OP} = 2\underset{\sim}{k} + 3\underset{\sim}{h}$

(ii)



$\overrightarrow{PQ} = -3\underset{\sim}{k} - \underset{\sim}{h}$

13 (a) $\sqrt{6}\, x = \sqrt{5}\, x + \sqrt{5}$

$$\sqrt{6}\, x - \sqrt{5}\, x = \sqrt{5}$$

$$(\sqrt{6} - \sqrt{5})x = \sqrt{5}$$

$$x = \frac{\sqrt{5}}{\sqrt{6} - \sqrt{5}}$$

$$= \frac{\sqrt{5}}{\sqrt{6} - \sqrt{5}} \times \frac{\sqrt{6} + \sqrt{5}}{\sqrt{6} + \sqrt{5}}$$

$$= \frac{\sqrt{5}\,\sqrt{6} + (\sqrt{5})^2}{(\sqrt{6})^2 - (\sqrt{5})^2}$$

$$= \frac{\sqrt{30} + 5}{6 - 5}$$

$$= 5 + \sqrt{30}$$

(b) $\log_8 p - \log_2 q = 0$

$$\frac{\log_2 p}{\log_2 8} - \log_2 q = 0$$

$$\frac{\log_2 p}{\log_2 2^3} - \log_2 q = 0$$

$$\frac{\log_2 p}{3} - \log_2 q = 0$$

$$\log_2 p - 3 \log_2 q = 0$$

$$\log_2 p = \log_2 q^3$$

$$p = q^3$$

(c) $3(2^{x+1}) + 2^x = 56$

$$3(2^1 \cdot 2^x) + 2^x = 56$$

$$6(2^x) + 2^x = 56$$

$$2^x(6 + 1) = 56$$

$$2^x = 8$$

$$2^x = 2^3$$

$$x = 3$$

14 (a) $PQ = PR$

$$\sqrt{(x - 0)^2 + (y - 2)^2} = \sqrt{(x - 4)^2 + (y - 0)^2}$$

$$x^2 + y^2 - 4y + 4 = x^2 - 8x + 16 + y^2$$

$$8x - 4y - 12 = 0$$

$$2x - y - 3 = 0$$

(b) $ST = 3$

$$\sqrt{(x - 3)^2 + (y - 2)^2} = 3$$

$$x^2 - 6x + 9 + y^2 - 4y + 4 = 9$$

$$x^2 + y^2 - 6x - 4y + 4 = 0 \quad ...... ①$$

(c) Midpoint of *QT*/*Titik tengah QT*

$= \left(\frac{0+3}{2}, \frac{2+2}{2}\right)$

$= \left(\frac{3}{2}, 2\right)$

Substitute/*Gantikan* $\left(\frac{3}{2}, 2\right)$ into/*ke dalam* ①.

$$\left(\frac{3}{2}\right)^2 + 2^2 - 6\left(\frac{3}{2}\right) - 4(2) + 4 = 0$$

$$\frac{9}{4} + 4 - 9 - 8 + 4 = 0$$

$$-\frac{27}{4} \neq 0$$

Hence, the midpoint of the straight line *QT* is not located on the locus of point *S*.
Maka, titik tengah garis lurus QT tidak terletak pada lokus titik S.

15 (a)

$$b^2 - 4ac < 0$$
$$k^2 - 4(1)(2k - 3) < 0$$
$$k^2 - 8k + 12 < 0$$
$$(k - 6)(k - 2) < 0$$
$$2 < k < 6$$

(b) (i)

$$px^2 + px + 3q = 1 + 2x$$
$$px^2 + px - 2x + 3q - 1 = 0$$
$$px^2 + (p - 2)x + 3q - 1 = 0$$

SOR/*HTP* : $\frac{1}{p} + q = -\left(\frac{p-2}{p}\right)$

$$\frac{1 + pq}{p} = \frac{-p + 2}{p}$$
$$1 + pq = -p + 2$$
$$pq + p = 1 \quad \text{...... ①}$$

POR/*HDP* : $\frac{1}{p} \times q = \frac{3q - 1}{p}$

$$q = 3q - 1$$
$$2q = 1$$
$$q = \frac{1}{2} \quad \text{...... ②}$$

Substitute ② into ①/*Gantikan* ② *ke dalam* ①.

$$p\left(\frac{1}{2}\right) + p = 1$$
$$\frac{3}{2}p = 1$$
$$p = \frac{2}{3}$$

(ii) New roots/*Punca baharu*:

$p = \frac{2}{3}$

$-2q = -2\left(\frac{1}{2}\right) = -1$

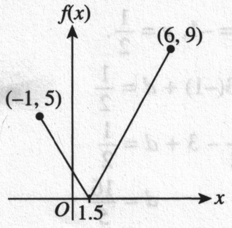
New quadratic equation:
Persamaan kuadratik baharu:

$$\left(x - \frac{2}{3}\right)(x + 1) = 0$$
$$(3x - 2)(x + 1) = 0$$
$$3x^2 + 3x - 2x - 2 = 0$$
$$3x^2 + x - 2 = 0$$

Kertas 2

1 (a)

x	-1	1.5	6
$f(x)$	5	0	9



$\therefore 0 \leqslant f(x) \leqslant 9$

(b)

$$f(x) = 3$$
$$|2x - 3| = 3$$

$2x - 3 = 3$ and/*dan* $2x - 3 = -3$

$2x = 6$ $2x = 0$

$x = 3$ $x = 0$

(c)

$$f(x) \leqslant 4$$
$$|2x - 3| \leqslant 4$$
$$-4 \leqslant 2x - 3 \leqslant 4$$
$$-1 \leqslant 2x \leqslant 7$$
$$-\frac{1}{2} \leqslant x \leqslant \frac{7}{2}$$

2

$$7x + 5y - 3z = 16 \quad \text{...... ①}$$
$$3x - 5y + 2z = -8 \quad \text{...... ②}$$
$$5x + 3y - 7z = 0 \quad \text{...... ③}$$

① + ②: $10x - z = 8$

$$z = 10x - 8 \quad \text{...... ④}$$

From/*Dari* ②: $3x - 5y + 2(10x - 8) = -8$

$$3x - 5y + 20x - 16 = -8$$
$$23x - 5y = 8$$
$$5y = 23x - 8$$
$$y = \frac{23x - 8}{5} \quad \text{...... ⑤}$$

From/*Dari* ③: $5x + 3y - 7(10x - 8) = 0$

$$5x + 3y - 70x + 56 = 0$$
$$65x - 3y = 56$$
$$65x - 3\left(\frac{23x - 8}{5}\right) = 56$$
$$325x - 69x + 24 = 280$$
$$256x = 256$$
$$x = 1$$

From/*Dari* ⑤: $y = \frac{23(1) - 8}{5} = 3$

From/*Dari* ④: $z = 10(1) - 8 = 2$

$\therefore x = 1, y = 3, z = 2$

3 (a) a = RM1 200 and/*dan* $r = 110\% = 1.1$

2030 – 2020 = 10

$$T_{10} = ar^9$$
$$= 1\ 200(1.1)^9$$
$$= \text{RM}2\ 829.54$$

(b) $T_n > 4\,500$

$1\,200(1.1)^{n-1} > 4\,500$

$1.1^{n-1} > 3.75$

$(n-1)\log_{10} 1.1 > \log_{10} 3.75$

$n - 1 > 13.87$

$n > 14.87$

$\therefore n = 15$

$T_{15} = 1\,200(1.1)^{14}$
$= \text{RM}4\,557.00$

Aiman needs 15 years for his savings to exceed RM4 500, where he can withdraw his money on 1 January 2035. He will get a total of RM4 557.00 at that time.

Aiman memerlukan 15 tahun untuk simpanannya melebihi RM4 500, *di mana dia boleh mengeluarkan wangnya pada* 1 *Januari* 2035. *Dia akan mendapat* RM4 557.00 *pada masa itu.*

4 (a) $\angle BOD = \frac{1}{3}\pi \text{ rad} = 60°$

Area of segment *BED*/*Luas tembereng BED*

$= \frac{1}{2}(9^2)\left(\frac{1}{3}\pi - \sin 60°\right)$

$= 7.343 \text{ cm}^2$

(b) $AC^2 = 9^2 + 9^2 - 2(9)(9)\cos 120°$
$= 243$

$AC = \sqrt{243} = 9\sqrt{3} \text{ cm}$

Arc/*Lengkok AB* + Arc/*Lengkok DC*
= Arc/*Lengkok AC* – Arc/*Lengkok BD*

$= 9\left(\frac{2}{3}\pi\right) - 9\left(\frac{1}{3}\pi\right)$

$= 3\pi \text{ cm}$

Perimeter of the shaded region
Perimeter kawasan berlorek
= $AC + BD$ + Arc/*Lengkok AB* + Arc/*Lengkok DC*
$= (9\sqrt{3} + 9 + 3\pi) \text{ cm}$

5 (a) PQ: $2x + 3y - 9 = 0$

$3y = -2x + 9$

$y = -\frac{2}{3}x + 3$

$\therefore m_{PQ} = -\frac{2}{3},\ m_{QR} = \frac{3}{2}$ and/*dan* $Q(0, 3)$

Equation of straight line QR:
Persamaan garis lurus QR:

$y - 3 = \frac{3}{2}(x - 0)$

$y = \frac{3}{2}x + 3$

(b) When/*Apabila* $y = 0$,

$0 = \frac{3}{2}x + 3$

$\frac{3}{2}x = -3$

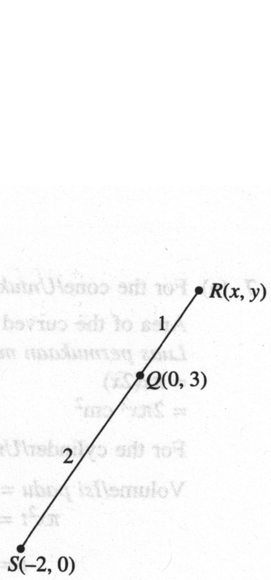
$x = -2$

$\therefore S(-2, 0)$

$\frac{1(-2) + 2x}{2 + 1} = 0$

$-2 + 2x = 0$

$x = 1$



$\frac{1(0) + 2y}{2 + 1} = 3$

$2y = 9$

$y = \frac{9}{2}$

$\therefore R\left(1, \frac{9}{2}\right)$

(c) Area of ΔOQR/*Luas* ΔOQR

$= \frac{1}{2}\begin{vmatrix} 0 & 0 & 1 & 0 \\ 0 & 3 & \frac{9}{2} & 0 \end{vmatrix}$

$= \frac{1}{2}\left|(0 + 0 + 0) - (0 + 3 + 0)\right|$

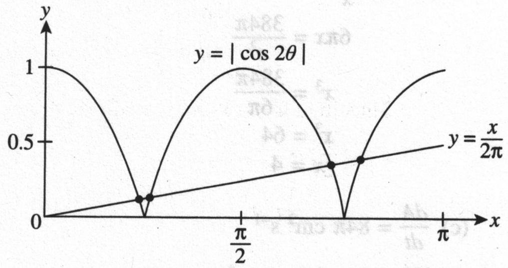
$= 1\frac{1}{2} \text{ unit}^2$

6 (a) $\cos 2\theta = \cos(\theta + \theta)$
$= \cos\theta\cos\theta - \sin\theta\sin\theta$
$= \cos^2\theta - \sin^2\theta$
$= \cos^2\theta - (1 - \cos^2\theta)$
$= \cos^2\theta - 1 + \cos^2\theta$
$= 2\cos^2\theta - 1$

(b) (i), (ii)
Since/*Oleh sebab* $2\cos^2\theta - 1 = \cos 2\theta$,

$y = |2\cos^2\theta - 1|$
$y = |\cos 2\theta|$

We can sketch the graph of/*Kita boleh lakar graf*:
$y = |\cos 2\theta|$



$x - 2\pi\,|2\cos^2\theta - 1| = 0$

$x - 2\pi\,|\cos 2\theta| = 0$

$2\pi\,|\cos 2\theta| = x$

$|\cos 2\theta| = \frac{x}{2\pi}$

The suitable straight line graph to be sketch is:
Graf garis lurus yang sesuai dilakar ialah:

$y = \frac{x}{2\pi}$

When/*Apabila* $x = 0$, $y = 0$.
When/*Apabila* $x = \pi$, $y = 0.5$.
Number of solutions/*Bilangan penyelesaian* = 4

7 (a) For the cone/*Untuk kon*:

Area of the curved surface
Luas permukaan melengkung
$= \pi x(2x)$
$= 2\pi x^2$ cm²

For the cylinder/*Untuk silinder*:

Volume/*Isi padu* $= 192\pi$ cm³
$\pi x^2 t = 192\pi$
$t = \dfrac{192}{x^2}$

Area of the curved surface
Luas permukaan melengkung
$= 2\pi x\left(\dfrac{192}{x^2}\right)$
$= \dfrac{384\pi}{x}$ cm²

Area of the base/*Luas tapak* $= \pi x^2$ cm²

Total surface area of the solid,
Jumlah luas permukaan pepejal,

$$A = 2\pi x^2 + \frac{384\pi}{x} + \pi x^2$$
$$= 3\pi x^2 + \frac{384\pi}{x}$$
$$= 3\pi\left(x^2 + \frac{128}{x}\right)$$

(b) $A = 3\pi x^2 + \dfrac{384\pi}{x}$

$$\frac{dA}{dx} = 6\pi x - \frac{384\pi}{x^2}$$

When/*Apabila* $\dfrac{dA}{dx} = 0$,

$$6\pi x - \frac{384\pi}{x^2} = 0$$
$$6\pi x = \frac{384\pi}{x^2}$$
$$x^3 = \frac{384\pi}{6\pi}$$
$$x^3 = 64$$
$$x = 4$$

(c) $\dfrac{dA}{dt} = 84\pi$ cm² s⁻¹

When/*Apabila* $x = 8$,

$$\frac{dA}{dx} = 6\pi(8) - \frac{384\pi}{8^2}$$
$$= 48\pi - 6\pi$$
$$= 42\pi$$

$$\frac{dA}{dt} = \frac{dA}{dx} \times \frac{dx}{dt}$$
$$84\pi = 42\pi \times \frac{dx}{dt}$$
$$\frac{dx}{dt} = 2$$

The rate of change of the radius is 2 cm s⁻¹.
Kadar perubahan jejari ialah 2 cm s⁻¹.

8 (a) (i) $\overrightarrow{AL} = \overrightarrow{AC} + \overrightarrow{CL}$
$= -6\underset{\sim}{y} + \dfrac{1}{4}(8\underset{\sim}{x})$
$= 2\underset{\sim}{x} - 6\underset{\sim}{y}$

(ii) $\overrightarrow{CB} = \overrightarrow{CA} + \overrightarrow{AB}$
$= 6\underset{\sim}{y} + \dfrac{1}{2}\overrightarrow{AD}$
$= 6\underset{\sim}{y} + \dfrac{1}{2}(\overrightarrow{AC} + \overrightarrow{CD})$
$= 6\underset{\sim}{y} + \dfrac{1}{2}(-6\underset{\sim}{y} + 8\underset{\sim}{x})$
$= 4\underset{\sim}{x} + 3\underset{\sim}{y}$

(b) (i), (ii)

Let/*Katakan* $\overrightarrow{CG} = h\overrightarrow{CB}$ and/*dan* $\overrightarrow{AG} = k\overrightarrow{AL}$.

$$\overrightarrow{CG} = \overrightarrow{CA} + \overrightarrow{AG}$$
$$h\overrightarrow{CB} = 6\underset{\sim}{y} + k\overrightarrow{AL}$$
$$h(4\underset{\sim}{x} + 3\underset{\sim}{y}) = 6\underset{\sim}{y} + k(2\underset{\sim}{x} - 6\underset{\sim}{y})$$
$$4h\underset{\sim}{x} + 3h\underset{\sim}{y} = 6\underset{\sim}{y} + 2k\underset{\sim}{x} - 6k\underset{\sim}{y}$$
$$4h\underset{\sim}{x} + 3h\underset{\sim}{y} = 2k\underset{\sim}{x} + (6 - 6k)\underset{\sim}{y}$$

Compare the coefficients of $\underset{\sim}{x}$ and $\underset{\sim}{y}$.
Bandingkan pekali $\underset{\sim}{x}$ *dan* $\underset{\sim}{y}$.

$4h = 2k$ $3h = 6 - 6k$
$2h = k$ $h = 2 - 2k$
$h = 2 - 2(2h)$
$5h = 2$
$h = \dfrac{2}{5}$

$$k = 2\left(\frac{2}{5}\right) = \frac{4}{5}$$

$\overrightarrow{CG} = \dfrac{2}{5}\overrightarrow{CB}$ and/*dan* $\overrightarrow{AG} = \dfrac{4}{5}\overrightarrow{AL}$
$\therefore CG : GB = 2 : 3$
$AG : GL = 4 : 1$

9 (a) $\dfrac{dy}{dx} = -2x$
$y = -x^2 + c$

$Q(4, 2)$: $2 = -4^2 + c$
$2 = -16 + c$
$c = 18$
$\therefore y = -x^2 + 18$

(b) Area of the shaded region/*Luas rantau berlorek*
$$= \int_0^4 y\, dx - 4(2)$$
$$= \int_0^4 (-x^2 + 18)\, dx - 8$$
$$= \left[-\frac{x^3}{3} + 18x\right]_0^4 - 8$$
$$= \left[-\frac{4^3}{3} + 18(4) - 0\right] - 8$$
$$= 42\frac{2}{3} \text{ unit}^2$$

(c) Volume of revolution/*Isi padu kisaran*

$= \int_2^{18} \pi x^2 \, dy$

$= \pi \int_2^{18} (18 - y) \, dy$

$= \pi \left[18y - \frac{y^2}{2} \right]_2^{18}$

$= \pi \left[\left(18(18) - \frac{18^2}{2}\right) - \left(18(2) - \frac{2^2}{2}\right) \right]$

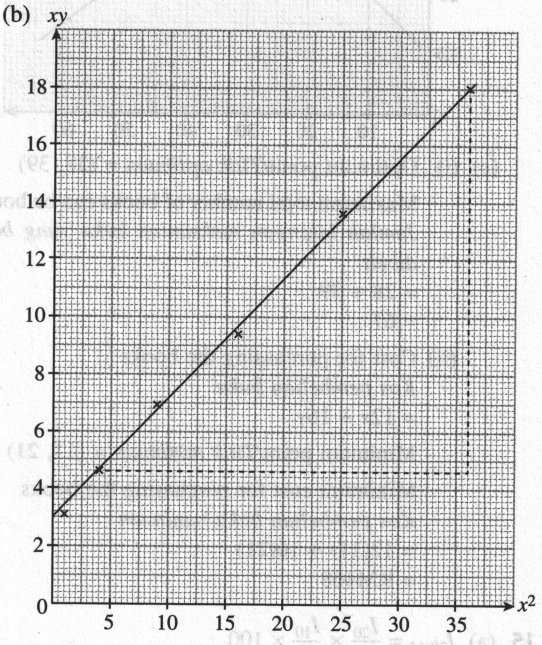
$= \pi(162 - 34)$

$= 128\pi \text{ unit}^3$

10 (a)

x^2	1	4	9	16	25	36
xy	3.10	4.60	6.99	9.40	13.60	18.00

(b)



(c) $y - px = \frac{q}{4x}$

$y = px + \frac{q}{4x}$

$xy = px^2 + \frac{q}{4}$

$Y = mX + C$

Gradient of the graph/*Kecerunan graf* :

$p = \frac{18 - 4.6}{36 - 4} = 0.4188$

y-intercept/*Pintasan-y*: $\frac{q}{4} = 3$

$q = 12$

11 (a) (i) $P(X \geqslant 3)$

$= P(X = 3) + P(X = 4) + P(X = 5)$

$= {}^5C_3(0.5)^3(0.5)^2 + {}^5C_4(0.5)^4(0.5)^1 + {}^5C_5(0.5)^5(0.5)^0$

$= 0.3125 + 0.15625 + 0.03125$

$= 0.5$

(ii) Mean/*Min*, $\mu = np$

$= 20(0.5)$

$= 10$

Standard deviation/*Sisihan piawai*,

$\sigma = \sqrt{npq}$

$= \sqrt{20(0.5)(0.5)}$

$= 2.236$

(b) (i) $Z = \frac{X - \mu}{\sigma}$

$2 = \frac{m - 46}{10}$

$20 = m - 46$

$m = 66$

(ii) $P(50 \leqslant X \leqslant 66) = P\left(\frac{50 - 46}{10} \leqslant Z \leqslant 2\right)$

$= P(0.4 \leqslant Z \leqslant 2)$

$= 0.3446 - 0.0228$

$= 0.3218$

Number of women/*Bilangan wanita*

$= 0.3218 \times 6\,000$

$= 1\,930.8$

$\approx 1\,931$

12 (a) When/*Apabila* $v_P = 0$, $2t - 6 = 0$

$t = 3$

Take O as the reference point.
Ambil O sebagai titik rujukan.

$s_P = \int (2t - 6) \, dt$

$= t^2 - 6t + c$

When/*Apabila* $t = 0$, $s_P = 0$. $\therefore c = 0$

$s_P = t^2 - 6t$

$s_Q = \int (5 - t) \, dt$

$= 5t - \frac{t^2}{2} + d$

When/*Apabila* $t = 0$, $s_Q = 8$. $\therefore d = 8$

$s_Q = 5t - \frac{t^2}{2} + 8$

When/*Apabila* $t = 3$,

$s_P = 3^2 - 6(3) = -9$ m

$s_Q = 5(3) - \frac{3^2}{2} + 8 = 18.5$ m

Distance between particles P and Q
Jarak di antara zarah P dan zarah Q

$= s_Q - s_P$

$= 18.5 - (-9)$

$= 27.5$ m

(b) Distance between particles P and Q
Jarak di antara zarah P dan zarah Q

$S = s_Q - s_P$

$= \left(5t - \frac{t^2}{2} + 8\right) - (t^2 - 6t)$

$= 11t - \frac{3}{2}t^2 + 8$

$\frac{dS}{dt} = 11 - 3t$

S is maximum when $\frac{dS}{dt} = 0$.

S adalah maksimum apabila $\frac{dS}{dt} = 0$.

$$\frac{dS}{dt} = 11 - 3t = 0$$

$$t = \frac{11}{3}$$

(c) When the particles P and Q meet, $S = 0$.
Apabila zarah P dan zarah Q bertemu, $S = 0$.

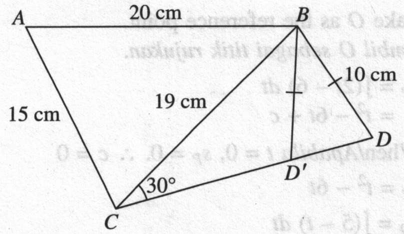
$$S = 11t - \frac{3}{2}t^2 + 8 = 0$$
$$22t - 3t^2 + 16 = 0$$
$$3t^2 - 22t - 16 = 0$$
$$(3t + 2)(t - 8) = 0$$

Since/*Oleh sebab* $t > 0$, $\therefore t = 8$.

When/*Apabila* $t = 8$, $s_P = 8^2 - 6(8)$
$= 16$ m

13 (a)
$$19^2 = 20^2 + 15^2 - 2(20)(15)\cos\angle BAC$$
$$2(20)(15)\cos\angle BAC = 20^2 + 15^2 - 19^2 = 264$$
$$\cos\angle BAC = 0.44$$
$$\angle BAC = 63.90°$$

(b)



$$\frac{\sin\angle BDC}{19} = \frac{\sin 30°}{10}$$
$$\sin\angle BDC = \frac{19\sin 30°}{10} = 0.95$$
$$\angle BDC = 71.81°$$
$$\angle BD'C = 180° - 71.81° = 108.19°$$

(c) (i) $\angle CBD = 180° - 30° - 71.81° = 78.19°$

$$\frac{CD}{\sin 78.19°} = \frac{10}{\sin 30°}$$
$$CD = \frac{10\sin 78.19°}{\sin 30°} = 19.58 \text{ cm}$$

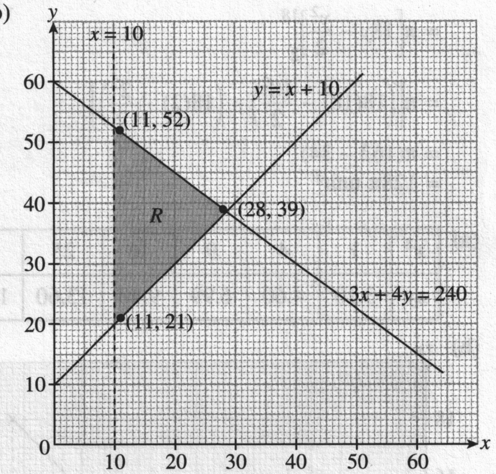
(ii) Area of quadrilateral $ABCD$
Luas sisi empat ABCD
= Area of ΔABC + Area of ΔBCD
Luas ΔABC + *Luas* ΔBCD
$= \frac{1}{2}(20)(15)\sin 63.90° + \frac{1}{2}(19)(10)\sin 78.19°$
$= 134.704 + 92.989$
$= 227.69 \text{ cm}^2$

14 (a) I : $12x + 16y \leqslant 960$
$3x + 4y \leqslant 240$

II : $x > 10$

III: $y \geqslant x + 10$

(b)



(c) (i) Optimum point/*Titik optimum* = (28, 39)
Maximum total number of books can be bought
Jumlah bilangan maksimum buku yang boleh dibeli
= 28 + 39
= 67

(ii) Cost for purchasing the books
Kos pembelian buku
$= 12x + 16y$
Minimum point/*Titik minimum* = (11, 21)
Minimum cost for purchasing the books
Kos pembelian buku minimum
= 12(11) + 16(21)
= RM468

15 (a) $I_{20/15} = \frac{I_{20}}{I_{10}} \times \frac{I_{10}}{I_{15}} \times 100$
$= 138 \times \frac{1}{115} \times 100$
$= 120$

(b) (i) $x = \frac{14.70}{10.50} \times 100 = 140$

(ii) $\frac{Q_{2015}}{10.50} \times 100 = 128$
$$Q_{2015} = \frac{128 \times 10.50}{100}$$
$= \text{RM}13.44$

(c) $\frac{128(2) + 115(2) + y}{2 + 2 + 1} = 125$
$256 + 230 + y = 625$
$y = 139$

(d) $\frac{49.90}{Q_{2010}} \times 100 = 125$
$$Q_{2010} = \frac{49.90 \times 100}{125}$$
$= \text{RM}39.92$

KERTAS MODEL SPM

Sijil Pelajaran Malaysia

FORMAT MULAI 2021

Additional Mathematics
Matematik Tambahan

(3472/1, 3472/2)

Judul-judul dalam siri ini:

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- Bahasa Inggeris 1119
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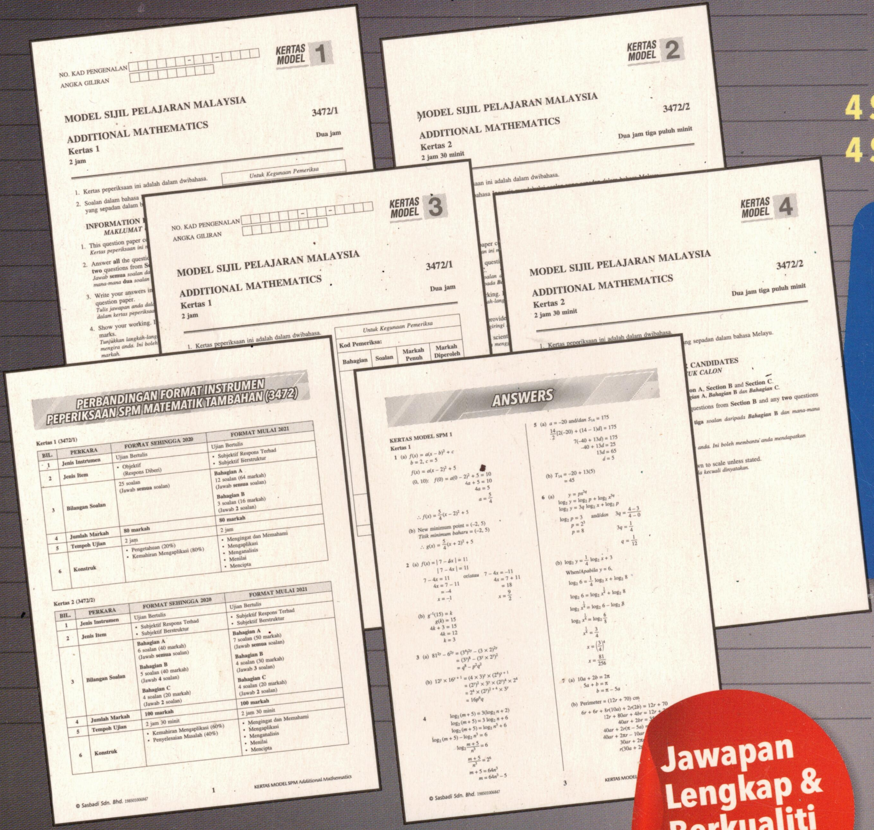
- Additional Mathematics/ Matematik Tambahan
- Science/Sains
- Fizik/Physics
- Kimia/Chemistry
- Biologi/Biology
- Sejarah
- Pendidikan Islam
- Pendidikan Moral
- Prinsip Perakaunan
- Perniagaan
- Ekonomi



4 Set Kertas 1 (Ujian Bertulis)
4 Set Kertas 2 (Ujian Bertulis)

Setiap set kertas model memenuhi piawai Contoh Pentaksiran SPM daripada Lembaga Peperiksaan

Setiap set dapat dileraikan

Rupa bentuk, format kertas & piawai soalan yang menepati keperluan terkini

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